CONSUMPTION, PRODUCTIVITY AND LABOUR IN RURAL SUDAN

by

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Summary

In this thesis four topics are studied empirically. These are the level and pattern of consumption, production efficiency, tenancy and rural-urban migration. The analysis is based on data collected from some villages in rural Sudan and other published data.

In the study of consumption, the demand for goods and services as related to the income level of households is analysed. The analysis reveals how would consumers allocate marginal increases in their income among the various goods. Income elasticities were also estimated and the price elasticities are derived for a number of commodity groups using an extended version of the linear expenditure system. The perceived minimum subsistence expenditures on some commodities were estimated. The implication of the magnitude of the estimated subsistence level on food for poverty and policy of economic development were then discussed. In this part of the study we also deal with the income distribution which is an important determining factor of the structure of demand.

The relationship between size of farm and output per acre is an important issue in production efficiency. We investigate this relationship and draw the implications for land distribution and land reform. One conclusion which emerges from the analysis is that efficiency and equity can be reconciled by the creation of a cooperative movement that could make available the agricultural inputs that farmers are lacking now and which enables risks in production to be undertaken jointly by those who participate in it.

In tenancy it is argued that its incidence can be explained largely by imperfections in the market for some factors. One such factor which is found to be positively correlated with land lease is the labour power which is available in the family. The availability of tractor service, hired largely by well-off households, is also found to be positively related to land hire.

Rural-urban migration is discussed within the broad framework of the socio-economic factors prevailing in the rural community at large and by focussing attention on some specific factors that are reflected at the household unit. Among the latter we examine the relationship of migration to the output and land holding per capita. The influence of other factors such as income earned outside the family farm, largely through the process of rural-rural migration, education and mechanization is also tested.

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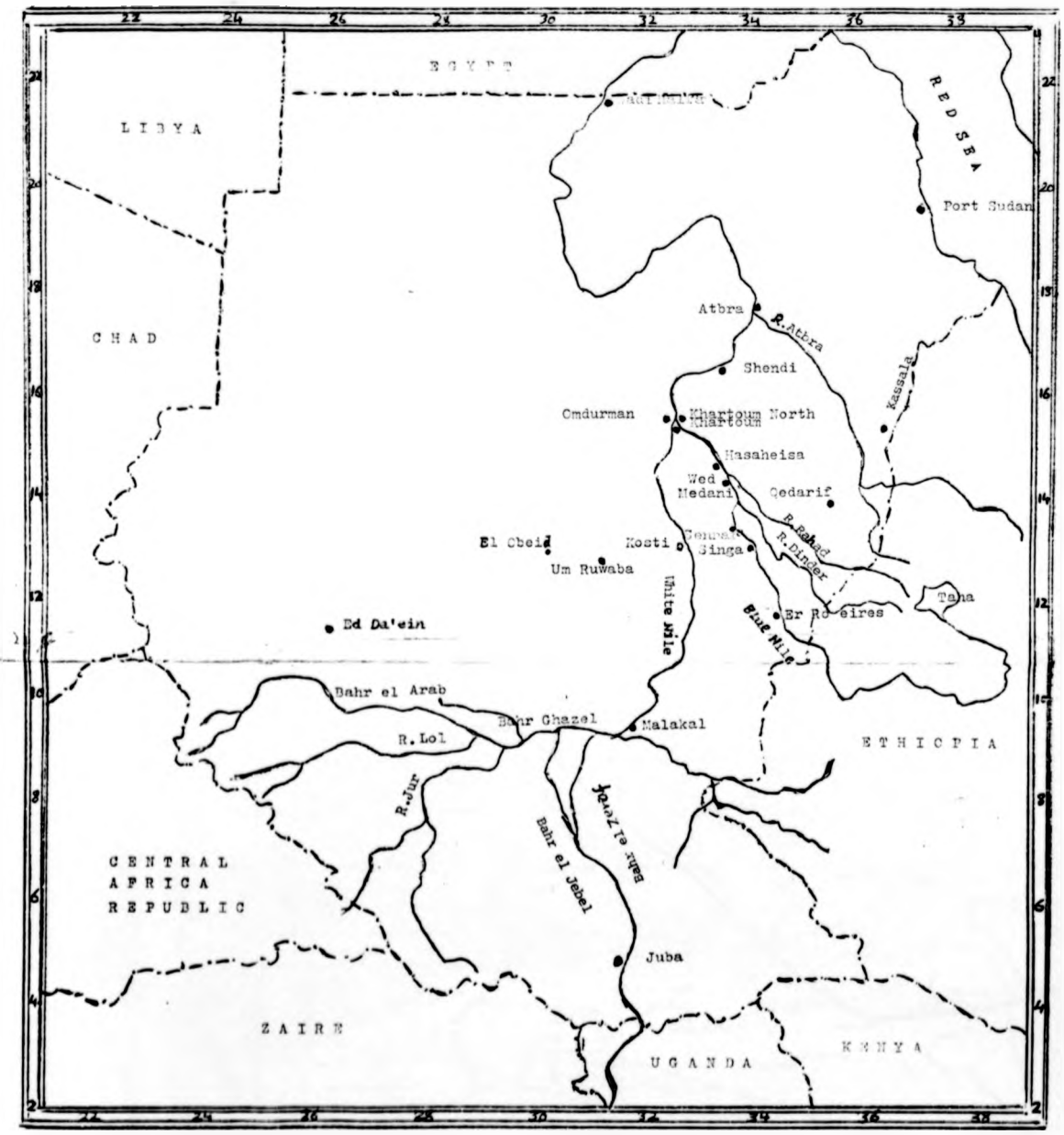

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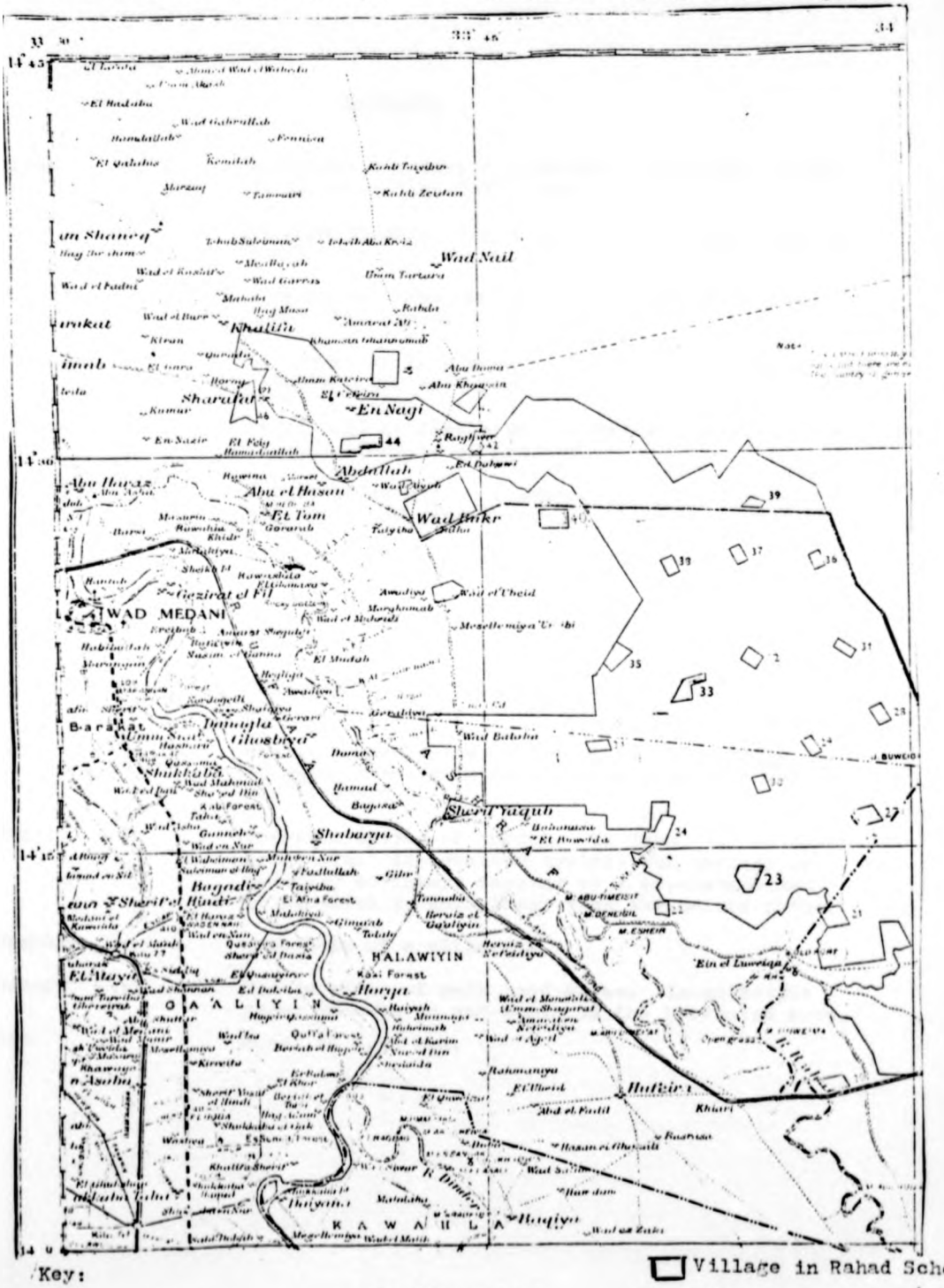

GLOSSARY

Ardab	:	A measure of weight for grains. An ardab of dura is equivalent to 332.5 lbs.
Dura	:	Sorghum Vulgare, the staple food of rural Central Sudan.
Dugundi	:	Fixed-cash lease contract which expires by the end of the agricultural year.
Feddan	:	A measure of land area in Sudan. 1 feddan = 1.038 acres = 0.420 hectares.
Jada'a	:	Local unit of land area in Central Sudan. It is roughly equal to 5½ feddans.
Kantar	:	A unit of weight. A kantar of cotton is equal to 100 lb. if ginned and 315 lb. if unginned.
Keila	:	Measure of capacity. A keila of dura is approximately equal to 12 kgs.
Lubia	:	Dolichos lablab, a bean grown mainly for fodder (but also for human food).
L.S.	:	Sudanese Pound. The pound is divided into 100 piasties (p.t.). Until 1979 L.S. 1 = $2.287.
Okra	:	Hibiscus esculentus, known in Sudan as Bamia or Weika when it is dry. Stew vegetable valued for viscosity.
Shail	:	Informal system of credit. In rural agricultural areas shail is advanced against the promise of delivery of future harvest at a pre-determined price which is much lower than the market price.
Shaykh	:	A headman of a village.
Ushur	:	Tax on crops of rain land areas. In principle ushur amounts to one-tenth of the harvested crop.
Ratol	:	Equal to 0.99 lbs.

INTRODUCTION

This study is concerned with an empirical analysis of four topics in the economics of agriculture in developing countries. These are the level and patterns of consumption, production efficiency, tenancy and rural-urban migration. The analysis will be concentrated on certain aspects of each of these issues and throws some light on the inter-relationship among them. As we shall see the market for factors, especially that of labour, will occupy an important place in delineating their inter-relation. The data on which the analysis is carried out were collected from the rural agricultural areas of Sudan.

The level of agricultural productivity and incomes in developing countries is so low that the majority of people in rural areas find it difficult to satisfy in an adequate manner their needs - in nutrition, clothing and housing. The low levels of income lead to the people's diet being composed mainly of poor varieties which results in insufficient calorie intake to such an extent that full growth and activity of people may be duly retarded. In this study we shall look at the consumption decisions by families and how they allocate their incomes among the various commodities and services. As will be argued these decisions have important implications for production performance. We shall also discuss some of the theoretical models which are advanced to explain how the level of wages is determined in rural areas and test the validity of some of their implications empirically.

An important issue in production efficiency which will be

discussed is the relationship between size of farm and productivity. The evidence from some developing countries suggests that output per unit of land is inversely related to size of farm, i.e. small farms have higher productivity per acre than large ones. The relationship will be examined and the hypothesis that small farms might have better access to inputs, such as family labour, than large farms, will be investigated.

There has been no comprehensive study concerning the tenurial arrangements in the traditional agricultural areas of Sudan. Evidence from sporadic writings suggests that share-cropping, as well as fixed rent tenancies exist in these areas. In the irrigated modern agriculture, on the other hand, the dominant form of contract is a share-crop contract between the farmers and the government. Invariably share crop contracts applied to the cash crops which are used mainly for exports. Therefore an understanding of the implications of the various forms of contract on the resource allocation and production efficiency should be important from the view point of improving the levels of income and welfare of rural populace. Regarding the allocation of inputs under share cropping contracts, it might be argued for instance that a share cropper, because he is required to share the output with the landowner, might apply less inputs in production. Share-crop contracts, however, may take account of such disincentive effects. The level of application of inputs may be specified by stipulating the cultivation procedures. Alternatively the costs of inputs may be shared and their application ensured by supervision. Such arrangements could result in production efficiency. The theoretical underpinnings of such

arguments will be studied. An important issue that needs to be examined is the factors underlying the existence of tenancy. It is argued, for example, that in a world where factor markets operate perfectly there would be no need for tenancy. Factor market imperfections, however, are an observed phenomenon in reality, and tenancies may result from an adjustment of land cultivated by farmers given their endowment of factors. For instance, under conditions of imperfect labour markets a landlord with an excess of land given the labour available to him may adjust his cultivated land by leasing out. On the other hand a tenant with an excess of labour given land may lease in land. An investigation of the relationship between the market for land and labour as well as for other factors e.g. capital services will therefore be carried out.

In studies of rural-urban migration "pull" factors occupy an important place in explaining the process of migration. Rural-urban migration is seen to be related to differences between expected urban and expected rural income over a certain period. That is the rate of migration depends in the models upon the extent to which the average wage in the urban modern sector discounted by the probability of an individual obtaining that income, exceeds the average marginal product in agriculture. The process of migration to urban areas, however, cannot be comprehensively understood in isolation from what is happening in the agricultural rural areas. There are many rural-end factors which have important influences on decisions of migration by a rural household which maximizes the welfare of its members. It is argued for instance that in the absence of rural credit the financial flows from migrants in urban areas could have an influence in migration decisions. These flows could be used in financing

investment that raises the level of production of households in rural areas. We shall, therefore, explore the factors that affect decisions to migrate at the household level and clarify the importance of rural credit in these decisions.

With the above brief account of the topics which will be analysed we set out to outline the structure of the study. Chapter 1 consists of an account of some features of Sudan's economy. The purpose of this chapter is to emphasize some aspects of agricultural economics in Sudan.

In Chapter 2 a theoretical discussion of some of the issues which will be examined empirically in later chapters will be given. In particular we concentrate on aspects of the theory of labour markets in developing countries and the allocation decisions by maximizing households of its labour which will provide guidance in the task of data analysis. We shall also examine the debate on the relationship between size of farm and productivity. A description of the data base on which the issues will be analysed will be provided. We shall give a picture of the villages from which the data were collected and the process of data collection.

In Chapter 3 we shall describe the markets for factors in the villages. We consider the land, labour, tractor and credit markets. The linkages between the markets which could have implications for resource allocation by the agricultural household will be exposed. The validity of some hypotheses relating to the labour markets which were reviewed in previous chapter are tested empirically.

The analysis of consumption and the demand for goods and services is given in Chapter 4. The analysis will enable us to relate in an economy with growing per capita income the spending pattern by families to the allocation of resources among the different productive activities. We shall also examine whether the consumption expenditure on "basic" food stuff of the average household falls below a level necessary to satisfy the basic needs of its members in nutrition. The income distribution which is an important determinant of the level and consumption pattern of the population will be studied. The objective from the analysis in this chapter is to point to some of the principles that must guide economic strategy if the aim of productivity growth and eradication of absolute poverty is to be satisfied.

In Chapter 5 we address ourselves to the question of production efficiency and look at the size-productivity relationship using our data set.

Tenancy is discussed in Chapter 6. At the outset a theoretical analysis of the relative efficiency of various forms of contract is offered. The Marshallian and Cheungian view of the efficiency of share-cropping will be presented. In the empirical analysis of this chapter our concern will be to test the factors responsible for the determination of tenancy.

Chapter 7 is concerned with rural-urban migration. Some models and a review of recent developments of rural-urban theory will be introduced at the beginning. We then look at how far the empirical studies of migration confirm the theoretical hypotheses as well as the shortcomings of these studies. In the discussion of migration

in our villages we commence by examining the pattern and extent of migration. A general picture of the socio-economic setting in the villages and its relation to migration will be drawn. The specific factors, however, which influence migration decision at the household level will be studied by estimating a migration function for the villages.

Finally in Chapter 8 we shall briefly put forward some tentative conclusions and derive some implications concerning policies. We conclude by some suggestions for future research.

CHAPTER 1 : Some Features of Sudan Economy

1.1 Introduction

This chapter gives a brief account of some general features of the Sudanese economy. It places much emphasis on the agricultural sector and the organisation of the sector. Section 1.2 describes the country, its area and population. A brief discussion of the historical background of present land ownership in Sudan is provided in this section. Section 1.3 outlines the different categories of employment of the labour force in the economy and in some sectors. In 1.4 the gross domestic income and the growth of the economy is set out. The agricultural sector and its characteristics are dealt with in section 1.5. In 1.5.1 we discuss the development of the agricultural crop production setor while in 1.5.2 some information on the livestock sub-sector are given. A final summary is given in section 1.6.

1.2 Location, Area and Population

Sudan lies between latitudes 3^{o}N and 23^{o}N and latitudes 21^{o}E and 39^{o}E. The country is entirely situated within the tropical zone and the annual rainfall ranges from almost none in the north to almost 18 cm. at Khartoum and to about 120 cm. in the south.

With an area of about one million square miles (2.5 million square kilometers or a total of 598 million feddans) Sudan is the largest country in Africa. Out of the total of 598 million feddans it is estimated that 200 million feddans are potentially usable for agricultural production of which 80 million represents range land.

Only a small percentage of the total cultivable area was used. In the 1977/78 for example the total area under main crops was 16.4 million, about 8% of potentially cultivable land (see below).

The 1973 population census gave a total population of 14.8 million, with a rate of growth of 2.14 per annum. The distribution of population between Sudan's different provinces and by mode of living is shown in Table 1.1 below.

Table 1.1 indicates that more than half the country's population in 1973 was concentrated in the former provinces of Blue Nile, Kordofan and Darfur, which account for 40% of the country's total area. 1/ Another feature revealed in Table 1.1 relates to the division of the total population between the urban and rural areas. In 1973 more than 81% of the total population lived in rural areas.

A rate of growth of 7.4 per cent per annum and 1.5 per cent per annum in the inter-censal period 1955/56-1973 has been estimated for the urban and rural areas respectively (El Hassan, 1976, p.4). With the majority of the population in Sudan living in rural areas and an average annual rate of growth of 2.14 per cent for the population the former figures would imply that much of the growth in urban areas could be attributed to rural-urban migration.

1/ Until 1974 the country is divided into 9 provinces. After this date restructuring of existing boundaries has led to an increase in the number of provinces to 18. As a result of this restructuring the Blue Nile Province is divided into three provinces: Blue Nile, White Nile and Gezira Province which are referred to as the Central Region.

TABLE 1.1 : Sudan Population by Province and by mode of living

	Land Area (000 sq. kilometers Gross)	Population (000's)		Annual[1] Growth Rate	Per cent urban in 1973	Per cent[3] rural in 1973
		1955/56	1973			
Bahr El Ghazal	214	991	1388	1.99	9.09	90.91
Equatoria	198	903	758	-1.036[2]	18.40	81.60
Upper Nile	236	889	799	- .621[2]	4.59	95.41
Northern	477	873	964	0.647	18.53	81.47
Khartoum	21	505	1150	4.85	71.58	28.42
Kassala	129	941	1572	3.00	21.81	78.19
Blue Nile	142	2070	3804	3.50	14.27	85.73
Kordofan	381	1762	2203	1.283	12.83	87.17
Darfur	496	1329	2181	2.85	9.08	90.92
Sudan	2506	10263	14819	2.14	18.46	81.54

(1) The figure includes a provision of 5% assumed underestimation for 1973 Census.

(2) The negative rate of growth appears to be due to abnormal situation then prevailing in these provinces.

(3) The rural percent includes both settled and roaming nomads.

Source: Department of Statistics, Sudan Second Population Census 1973 (Khartoum, 1977), p.1, p.2 and p.3.

Another characteristic revealed by the 1973 population census is that 45.8% of the total population is under fifteen years of age. This would suggest that the population of Sudan is fairly young. The census also indicated that Sudan, unlike some developing countries which suffer from population pressure, is sparsely populated, with a population density of 5.9 persons per square kilometer. And when some vast areas of desert and unproductive land is excluded the density is slightly higher rising to 6.9 square kilometers. While the low population density means that Sudan is unlikely to face a population pressure or a shortage of cultivable land in the near future, it is unfavourable to economic development in other respects. The setting up of infrastructure which is necessary for the process of development, like transport networks, would involve high overhead costs and require vast amounts of capital investment. On the other hand the low population density means that in the short run Sudan might face a labour shortage particularly when large agricultural schemes planned by the government in its recent development programmes are completed. Resort of course could be made to capital intensive methods. The country had in fact already embarked on this with the mechanization of most of the agricultural operations in some of the newly created schemes, e.g. Rahad.

Whereas Sudan is unconstrained by unavailability of land it is restricted in the amounts of water which it can use for irrigation of its land, the main source of which is the Nile river. In this respect Sudan is governed by the 1959 Nile Waters Agreement with Egypt. According to the agreement Sudan's share reached 18½ milliard cubic metres. The Jongeli canal which is under construction in the Southern region will capture a large amount of water which used to be lost yearly in the Sudd region through precipitation and evaporation.

After its construction an amount of 2.4 milliard cubic metres measured at Malakal (o.9 milliard cubic metres at Aswan) will be added to Sudan's share (Abdel Salam, 1976, p.65).

A distinctive aspect relating to land in Sudan is the absence of big private landlordism. The system of land ownership in Sudan is characterised by the existence of individual ownership of land in the northern part of the country along the Nile banks and a communal and collective possession in the central plains and in the southern region. The system of private ownership and tribal communal ownership in the northern part of Sudan has its roots since the Arabs started to enter Sudan in 641 (Awad, 1971). In places where land is privately owned theplots owned are often small in size. This is a result of the application of Islamic Shariah law of inheritance. According to these laws land could be divided among the immediate relations of the deceased in unequal shares according to the strength of the blood tie between the dead person and his heir and whether the heir is male or female. On the other hand in places where land is communally owned each tribesman has the right to cultivate and graze his animals in the tribe's territory (known as dar). The area alloted to a man by the tribe's head is supposed to be no more than he can work (Kifayat yed) (Awad, 1971 ; Bolton, 1954).

The system of private and communal ownership of land in the northern part of the country had not, however, remained intact throughout the centuries. It had undergone some changes under the different political regimes and its restoration was due to the Anglo-Egyptian rule (1899-1955). A far reaching change occurred during the period

of the Funj Kingdom (1504-1821). At thetime of its rule, the royalty at Sennar (the kingdom Capital) started to bestow large pieces of land on religious and notable personalities. This had led to the emergence in the central region of the country of a feudal type of agriculture with few individuals owning most of the agricultural land. Various land tenural arrangements emerged including fixed rent as well as share cropping cultivation. During the period of Mahdist rule (1885-1898) the ownership of land territories was transferred from disloyal factions to loyal ones, and large areas of cultivable land turned into waste land after the occupants had been massacred or forced to migrate. However, as soon as the regime collapsed the expropriated and abandoned land reverted to its original owners (Awad, 1971). With the advent of the Anglo-Egyptian condominium in 1899 a firm policy regulating ownership of land was initiated. As a result of the Titles of Lands Ordinance which was passed in 1899 and the proclamations of 1905 concentration of large plots of land and speculation in land was limited greatly and made government control of land an easy task. Under the 1899 Ordinance possession or rentof land for five years prior to the date of claim gave absolute title. And in the absence ofany superior claim, evidence of continuous possession since the reconquest gave an effective title to land. (Gaitskell, 1952, pp.42-44). A final blow to the people claiming large plots of land in the central area came when the Gezira sheme was established in 1925 (more on Gezira in later sections). All land under the scheme was hired compulsory from their owners by the government at an annual rent of P.T. 10 per acre. The owners of land which was thus rented or acquired by the government were given preference in the allotment of tenancies (Gaitskell, 1952). The limited size of the

tenancy (30 feddans and recently reached 40 feddans, half of which is left fallow) excluded the possibility of people acquiring large plots of land.

Prior to 1970 the settlement of right to land and the registration of title to those rights are provided for in Sudan by the Land Settlement and Registration Ordinance 1925 (El Mahdi, 1975). Prima facie all unregistered land is deemed to belong to the government, but in practice the government exercises its ownership as a trust for the people who have habitually exercised rights over it. Settlement and registration of land have been carried out mainly in the Northern, Khartoum and Blue Nile Provinces. In 1970 the Unregistered Land Act was proclaimed. In its essence the act transferred the presumptive ownership by the government of unregistered land to full government ownership and the registration of that right in the name of the government. Provisions were made for those cases where unregistered land has been used by private persons for a long time or made any beneficial use of any land which is the property of the government by virtue of the Act. In the former case persons may be exempted from the acquisitive effect of the Act while in the latter compensation may be paid for the use of land (El Mahdi, 1975).

One should observe however that, in practice, administration of land (its distribution) in rural agricultural areas, usually becomes effective when the government establishes some schemes in these areas.

As will become clear later, when such schemes are set, standard allotments of land are allocated to individuals. In irrigated agriculture the size of the allotment varies between 20 and 40 feddans. In mechanized rainfed cultivation areas, on the other hand, where land is distributed by the government the size of land allocated to individuals could reach as high as 1500 feddans.

1.3 Modes of Employment

In Table 1.2 a breakdown of the economically active population in terms of modes of employment in the aggregate as well as for different sectors is presented. The data are computed from the Sudan Second Population Census 1973.

TABLE 1.2 : Breakdown of the Economically Active Population according to Employment Status : Total and Sectoral (percentages).

	Employer	Own Account	Employee	Unpaid Family Worker	Unpaid worker for others	Unemployed
Total(1)	2.83	55.45	26.23	9.41	0.079	5.98
Agriculture	3.36	71.60	10.47	14.02	0.024	0.51
Manufacturing	2.51	46.88	48.41	1.60	0.22	0.36
Commerce	6.71	70.62	20.33	1.78	0.10	0.38

Source: Department of Statistics, Sudan Second Population Census 1973. (Khartoum, 1977). Percentages are computed from Table 15(a), p.42.

(1) Apart from the three sectors covered in the table, the 'total' figures incorporate data for 'mining and quarrying', 'electricity, gas and water', 'construction', 'Transport, storage and communication), 'Financing, insurance, real estates', 'community, social and personal services', and 'activities not adequately defined'.

Table 1.2 is revealing in a number of ways. It indicates that more than a half of the economically active population engage in own account work. Wage-employment comes second in importance, with more than a quarter in the total economically labour force deriving their livelihood from hiring their labour. The third important category of employment appears to be that of unpaid family work. Secondly, the importance of 'employees' seems to be much greater in manufacturing than in the other two sectors. In contrast in agriculture the importance of the non-wage sector is much greater. Thirdly, the unpaid family worker comes second as a category of employment in the agricultural sector. The other thing which emerges from the table is the high rate of open unemployment among the economically active population. About 6 % of the labour force was unemployed according to the 1973 Population Census. The figures in the latter indicate that much of the unemployed are in the residual category of the 'activities not adequately defined'. This could imply that much of the unemployment is concentrated among the 'unskilled'; those who can do all sorts of jobs many of whom are to be found in the 'informal' sectors of the economy. Primary and Junior Secondary school leavers and immigrants from the traditional agricultural areas in urban centres with undefined skills constitute the majority of the former. Unemployment, however, is by no means confined to the category of "open" unemployment, which exist mostly in the urban modern sector of the economy. A high degree of underemployment is expected to prevail in the agricultural sector. In the traditional rainfed sector, in particular, the population remains unemployed for most of the year.

1.4 Gross Domestic Product

Table 1.3 shows the GDP at current market prices and the relative contribution of each sector for the years 1969/70-1978/79. The table denotes the importance of the agricultural sector in the Sudanese economy. Though the agricultural sector exhibits a declining share in the GDP it is still the largest contributor to the national income. In 1973/74 it contributed 41.4% to the economy's GDP. The fluctuating share of agriculture to the GDP can be attributed to the influence which natural as well as market factors have on the sector. The commercial sector comes second in its contribution to GDP, reaching 17.1% in 1975/76. The building and construction sector showed a rising trend during the period with its share approaching 6% in 1978/79. Another sector which shows an increasing share in GDP is the transport and communication sector. This can be attributed to the government's efforts to improve and construct a network of roads which connects areas of production to areas of consumption and to the country's port at the Red Sea. The contribution of the industrial sector to GDP is virtually constant, with a share of 8.9% for the years 1970/71-1972/73 and 9.4% for 1975/76-1977/78. Nevertheless manufacturing industry has been showing a rising rate of growth over the last decade. Over theperiods 1956/60, 1960/64 and 1965/70, the rate of growth of manufacturing industry averaged 6.1%, 9.1% and 9.4% respectively. (Numeri 1976, p.80). Despite the growth of the manufacturing sector, it has been argued that its contribution to the employment creation in the country has been unimpressive. It is believed that the rate of growth of employment in the industry has been very small compared with the growth in urban labour force. The industry is essentially import

substitution oriented, processing agricultural raw materials and producing light consumer goods for thelocal market. It is argued that the industry is biased towards the employment of capital-intensive techniques in production. This is explained in terms of some institutional factors and government policies which make the price of capital cheaper compared to labour. The institutional factors include the legislation of a minimum wage and government policies include its fiscal and monetary policies. The latter comprise exemption from import duties for the imported capital equipment and materials and the often over-valued exchange rate. In addition to these factors, the pattern of investmentin the manufacturing sector indicate that a large share of theinvestment in theindustry is concentrated on activities which are not employment absorbing, e.g. building materials.

It seems doubtful whether a calculation based on the series for the GDP presented in Table 1.3 would give a precise figure for the rate of growth of the G.D.P. The series anyway is for GDP at current priceswhich have been on a rising trend over the past decade. Further, Safi El Din (1977) casts some doubts on the way the National Income Division of the Department of Statistics estimate the national income. His scepticism was shared by some international institutions (the IBRD Statistical Review Mission which visited Sudan in November-December 1973 and the ILO/UNDP employment mission which visited Sudan in October 1975) (Safi El Din, 1977). The ILO employment mission to Sudan presumed that the rate of growth of GDP in real terms for the period 1956-1973/74 must have been somewhere between 3 to 4 per cent per annum (ILO, 1976a) Safi El Din (1977) using his own method for estimating

TABLE 1.3 : Gross Domestic Product by Sectors at current market prices 1969/70-1978/79 (Percentages)

Sector	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79
GDP at Current Prices (L.S.Million)	701.5	761.2	832.4	896.8	1246.2	1510.8	18.48	2117.5	2426.3	2784.7
Agriculture	37.6	38.7	38.9	38.4	41.4	38.7	33.9	33.4	32.8	32.1
Mining & Petrification	0.3	0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Processing Industries	9.3	8.9	8.9	8.9	9.6	9.2	8.4	8.4	8.4	8.3
Water & Electricity	2.4	2.3	2	1.5	1.4	1.5	1.5	1.4	1.3	1.1
Building & Construction	3.5	3.1	3.2	3.5	4.9	4.3	4.8	5.2	5.5	5.9
Commerce	14.6	14.9	16.9	15.9	14.1	16.2	17.1	16.7	16.3	15.9
Transport & Communication	7.3	6.7	6.2	6.9	6	5.9	10.4	11	11.7	12.4
Government Services	11.6	11.5	11.8	11.7	10.3	10	9.2	9.4	9.5	9.7
Other Services	13.5	13.9	- 11.8	12.4	12.9	13.9	14.2	14.2	14.2	14.2
Total	100	100	100	100	100	100	100	100	100	100

Source: Ministry of Finance and National Economy, Economic Survey 1978/79 (Khartoum, 1979), pp.9-10.

the GDP found that in real terms the average rate of growth of total GDP during the period 1966/67-1969/70 was 3.5%. For the period 1970/71-1974/75 he derived an average rate of growth of 4.4% for the economy (p.123).

1.5 Agriculture

The economy of Sudan is dominated by agricultural and pastoral activities. As we have seen above about two fifths of the country's GDP originate in the agricultural sector. The sector also stands out as a major contributor in terms of employment. The 1973 population census indicates that 65% of the economically active population in Sudan are engated in agriculture. The figures implied in the 1955/56 population census were higher. The latter census implied a figure of 80%. For rural Sudan where 81% of the population of Sudan lives, the 1973 census indicates that 78% of the economically active population derive their livelihood from agriculture.

The economy also depends heavily on the agricultural sector for earnings of foreign currencies. This fact is reflected Table 1.4 which shows the percentages of the main items of exports.

Sudan's exports thus are mainly agricultural raw material commodities. And among these one crop, viz, cotton, is the main source of foreign exchange earnings. In 1979, 65% of the foreign exchange earnings are provided through sales of cotton.

TABLE 1.4 : Main items of Exports as percentage of the total value of exports during the period 1972-1979 (percentages)

Source	1972	1973	1974	1975	1976	1977	1978	1979
Cotton	58.6	55.6	35.5	46.0	50.7	57.2	51.8	65.0
Groundnuts	7.8	8.5	14.9	22.6	20.2	12.5	10.2	4.3
Sesame	7.4	7.0	13.5	7.8	9.0	7.9	9.5	2.7
Gum Arabic	7.3	4.9	11.7	5.0	5.9	5.9	7.3	8.0
Cake & Meal	3.5	5.2	1.8	2.7	2.6	3.4	3.3	3.2
Others	15.4	19.0	22.6	15.9	11.7	13.1	17.9	15.8
Total	100	100	100	100	100	100	100	100

Source: Bank of Sudan, Annual Report (Khartoum, 1979), p.30.

Beside being an earner of foreign currencies which are needed for importation of capital goods that are indispensable in the process of development, its role is by no means limited to this function. Among its other functions which is recognised in many government documents (Ministry of Planning, 1976) is to maintain an expansion of food supplies to keep pace with the growth of demand. Failure of food supplies to keep pace with the demand is likely to lead to a substantial rise in their prices. This in turn could lead to pressure on wage rates, with consequent adverse effects on industrial profits, investment and economic growth. Agriculture also is the main source of raw materials for the industrial sector in Sudan which is largely composed of food processing and textile industries.

The reliance of the economy on agriculture has led the successive Governments to allocate large amounts of investment to the sector relative to other sectors' share. Distribution of public sector

investment between the sectors in three national plans since independence is shown in Table 1.5.

TABLE 1.5 : Distribution of Public Investment by Sectors in three development plans (in millions L.S).

Sector	Ten Year Plan 1961/62-1970/71 L.S. million	%	Five Year Plan 1970/71-1974/75 L.S.million	%	Six Year Plan 1977/78-1982/83 L.S.million	%
Agriculture and Irrigation	90	32	81	39	425	27
Industry and Mining	42	15	49	24	335	22
Transport and Communication	63	21	30	14	320	21
Social Services	90	32	45	22	265	16
Reserve Fund	-	-	-	-	225	14
Total	285	100	205	100	1570	100

Source: Ministry of Planning, Six Year Plan for Economic and Social Development 1977/78-1982/83 (Khartoum, 1976), Volume 1 p.58 and p.64.

As Table 1.5 shows agriculture's share in the total public investment was 32, 39 and 27 per cent in the Ten, Five and Six Year Plan respectively. The share of agriculture in private investment on the other hand was smaller compared with its share in public investment. Investment of private enterprise is concentrated in industry, transport and buildings as the following Table reflects.

According to the recent publications by the Ministry of National Planning (1979) the performance of the agricultural sector was described as being satisfactory. Compared to other African

TABLE 1.6 : Distribution of Private Investment by Sectors in the Ten and Five Year Plan (in million L.S)

Sector	Ten Year Plan 1961/62-1970/71 L.S million	%	Five Year Plan 1971/71-1974/75 L.S million	%
Agriculture	30	16	27	16
Industry	65	35	24	14
Transport	32	17	30	18
Social Services (mainly housing)	60	32	88	51
Other	-	-	1	1
Total	187	100	170	100

Source: Ministry of Planning, Six Year Plan for Economic and Social Development 1977/78-1982/83 (Khartoum. 1976), Volume 1, p.65.

countries particularly the West African Sahelian countries during the seventies, Sudan has not suffered serious food shortages. Sudan was fortunate to have self sufficiency in the basic food staple, dura (sorghum). The Ministry of Planning (1979) estimates that during the period 1970-1977 agricultural production (including production of primary commodities) registered a real growth rate of 3.1% per annum, which was marginally ahead of the rate of increase in population. Nevertheless Sudan still imports large amounts of the basic food commodities and consumption goods. Table 1.7 shows Sudan's imports by commodity for theperiod 1976-1979.

The figures displayed in Table 1.7 suggest that in 1979 one eighth of the total imports bill went to the importation of the total food stuff. Wheat and its product took 37% in the value

TABLE 1.7 : Imports by Commodity (in L.S.000's)

Commodity	1976	1977	1978	1979
Wheat	11731	6488	5955	9736
Wheatflour	636	2	2870	12271
Rice	141	166	301	1440
Lentils	363	1053	672	663
Sugar	21951	13340	18930	20279
Tea	3875	6551	17398	6185
Coffee	2095	1695	5	1598
Dairy Products	1379	1712	2994	2025
Other Food Stuff	3069	4646	5965	5419
Total food stuff	45240	35753	54890	59816
Drinks & Tobacco	6268	6061	6981	3239
Crude materials	31926	45607	50806	73173
Chemicals	33425	32688	41608	48815
Manufactured goods	5004	63867	88334	93800
Machinery & Equipment	110594	125619	111975	100796
Transport Equipment	43625	39659	57510	70956
Textiles	21466	28232	37360	26723
Grand Total	340948	377486	449464	477318

Source: Bank of Sudan, Annual Report (Khartoum, 1980), computed from Appendix III, pp.114;119.

of the imported food stuff in 1979. Considering that in the Six Year Plan 1977/78-1982/83 the demand for wheat was supposed to be met entirely from home production by 1978/79 the above fact would indicate that the plans were very optimistic. The importation of consumption goods would mean that the country is deprived of much of the foreign currency which could have been used for the purchase of capital requirements. Machinery and inputs for the agricultural production (like fertilizers and insecticides) seem to be particularly needed in the agricultural sector . The growth in demand for these inputs in recent years is precipitated by Government policies regarding the development and investment in the agricultural sector.

1.5.1. Development of the Agricutural Crop Production Sector

The government investment in the sector is concentrated in irrigated agriculture. The development policies in the latter followed the example of Gezira Scheme. The latter lies in the area between the Blue Nile and White Nile south of Khartoum. The Scheme was established in 1925 during the period of the Anglo-Egyptian condominium (1899-1955). The area under the scheme is irrigated from a dam at Sennar through gravity irrigation. Area under the scheme has been growing rapidly since its establishment and it stands now at 2.1 million feddans. The scheme's land was distributed into tenancies of 30 feddans each to the people living in the area. As we mentioned before in the distribution of tenancies owners of land in the area, from whom the land was rented at a rate of ten piastres per feddan, were given priority. If a person owns more than he and his own family can manage he could nominate any member

of his family and kin relatives and thereafter land would be offered for other people in the village who want to cultivate. The tenancy was allocated mainly to the production of cotton which is allotted 10 feddans. Part of the tenancy (5 feddans) was allocated to production of subsistence crop, dura, and fodder for animals (lubia), each occupying two and a half feddans. The rest of the land is left fallow as a measure for fighting diseases and to help the land to have a period of rest during which it regains fertility.

The tenants together with the condominium government and Sudan Plantation Syndicate (SPS), a British company, represented the three partners who run the scheme. The government built and maintained the irrigation works in return for 40% in net cotton proceeds. The SPS managed production on a 25 year concession and supplied all other capital inputs in return for a 20% share. The remaining 40% share went to tenants for labour. The net proceeds of cotton were arrived at after deduction of certain costs which are borne jointly by the three partners. These include the costs of ploughing, ginning, transport of cotton to Port Sudan and such inputs as seeds, pesticides, and sacks which were provided by the management. In addition to the 40% the tenants have full possession of the subsistence crop and the fodder grown in the tenancy. By independence in 1956 the colonial administration had nationalized the management function under Sudan Gezira Board (SGB). The sharing arrangementhas undergone changes during the years. Until recently these shares used to stand at 49, 36 and 10 per cent for the tenants, government and Board. The 49% of the tenants' share include 2% for the Tenant's Reserve Fund which is an equilization fund maintained at 25 pounds per feddan sown under

cotton. The rest of proceeds were allocated between the local government and the Social Development Department of the Scheme.

When the scheme was first established it was assumed that the tenant and his family would provide most of the labour required for production. It is conceived at any rate that the tenant might require to hire in some additional labour especially during the peak periods of cotton harvesting. Among the facilities which were offered by the management was in fact theprovision of loans at a minimum interest for hiring of labour for cotton harvest. The cost of hired labour was not included in the costs which are deducted from the gross proceeds of cotton before the shares are divided and was entirely borne by the tenant. Seldom, however, were the loans enough to cover all the cost of hired labour. Thus, the tenants found it inevitable to resort to money lenders in the village to acquire loans at high interest rates. These money lenders are usually the village shopkeepers who trade mostly in dura. The shopkeeper usually advanced the money to the tenant, against the promise of delivery of future harvest of dura at a pre-determined price which is much lower than the market price.

Hired labour was largely recruited from labour in the western provinces in the country by direct contact and transport of labour to the scheme. The organization of labour recruitment involved a number of participants, including scheme management, government bodies, tenant committees and private contractors. In the scheme 75 per cent of cotton picking labour came to be recruited by tenant committees assisted by management.

In recent years it is felt that the scheme is facing a labour shortage particularly during cotton harvest time. This, it is believed, is caused partly by an increasing dependence of tenants on hired labour. Among the reasons which were offered for the latter phenomenon is the large size of the tenancy. Due to the government policies of diversification and intensification of the production the size of tenancy was increased to 40 feddans in recent years and part of the fallow are now being replaced by groundnuts and wheat.[3/] As a result the cropping intensity in the scheme has reached 82% and in some areas (Mangil extension) 100%. The agricultural year now proceeds as follows:

July	Dura and Groundnuts are sown
August	Cotton is sown
September	Thinning and weeding of cotton Lubia is sown
October	Weeding and spraying of cotton and dura
November	Ploughing and preparation of next season's cotton land. Wheat is grown
December	Dura Harvest. Some cotton picking
January	Cotton picking. Lubia is ready for grazing
February	Continuation of cotton picking
March	Continuation of cotton picking. Wheat harvest
April	End of cotton picking. Animals are let into cotton field to graze. Beginning of pulling out of cotton stalks
May-June	Cotton pulling and burning of debris

The agricultural operations as obvious from the schedule overlap and make the whole year busy except for the last two months

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3/ The intensification and diversification policy has been cited as one reason for the falling yields in crops in Gezira in recent years as it has led to declining soil fertility.

of the cycle when the pace of work slows down a little. It is argued that this level of high organization of agriculture with its introduction of scientific cropping patterns and regular watering required more observance, attendance and commitment on the part of the tenant. This meant that demand for labour of the tenant and his family needs to be extended greatly. Hence the increased demand for hired labour to help in some of the operations. The generally poor diet of the tenants which have the effect of reducing stamina and endurance for heavy and long hours of work was also cited as a reason for the failure of the tenants to provide all the labour required. An additional reason offered for dependence of tenants on hired labour is that the change which occurred in the demographic structure of the family through the years and the drift of the educated offspring to towns has the effect of reducing the supply of labour by the family.

Another problem which is faced by the Gezira Scheme relates to the sharing practice of the proceeds of cotton. It has been argued that the practice of sharing of cotton proceeds has led farmers to put more effort on the other crops, the proceeds from which accrue solely to them. Thirdly, it has been argued that the rising cost of insecticides, pesticides and fertilizers in recent years has increased the cost of production of cotton and reduced the returns from it. The rising costs of farm inputs and a shortage of supply have often led to insufficient application. Coupled with a lack of machinery for deep ploughing this had resulted in low productivity and deterioration of output per feddan. Table 1.8 shows the total areas and output per feddan of long staple cotton in the scheme for the

period 1976/77-1980/81.

TABLE 1.8 : Total Area and output per feddan of long staple cotton in Gezira

Year	Area (000's) Feddan	Yield in Kantar per feddan
1976/1977	485	3.6
1977/1978	474	4.0
1978/1979	409	2.9
1979/1980	446	2.5
1980/1981	427	2.1

Source: Bank of Sudan, Annual Report (Khartoum, 1982), Appendix V, p.118

In an attempt to promote productivity in the scheme the government has recently abolished the sharing arrangement and replaced it by a fixed rent charge. Starting from season 1981/82 a land and water charge was imposed on all crops in Gezira and other agricultural schemes. Under the new system individual tenant's accounts were introduced and will be debited with the cost of services rendered by the government and Board. The system of fixed rent charge, it has been argued, by allowing the tenants the full fruits accruing from the application of their labour, will provide an incentive for tenants to work harder than under the share contract. It could be argued (Chapter 6) however that share cropping contract could be as efficient as fixed rent contract under certain arrangements. For example if costs of inputs is shared and their application is supervised an efficient resource allocation under share cropping could be attained. As we mentioned above the cost of one variable input (hired labour) was not shared between the tenants

and the management and was paid solely by the individual tenants.

Another scheme neighbouring Gezira is El Rahad, which lies to the east bank of El Rahad river, one of the Nile tributaries. The scheme is a new one, which started production in 1977/78. A total area of 800,000 feddans is planned to be cultivated when the scheme is completed. The water for the project is drawn from the Blue Nile. An electricity powered pumping station was established at Meina on the Blue Nile. A supply canal, 84 km. long, carries water from Meina to an out-fall on Rahad River. From there a network of canals distributes water to the scheme's land.

Before the scheme was established the government completed cadastral surveys and registration to establish rights and titles in the project area. These would be extinguished by compensation, either by payment or by award of tenancies in the project. Tenancies in the scheme are 24 feddan in size. Each tenancy will comprise a 6 cropping units of 4 feddan each. The annual cropping pattern on the 24 feddan tenancy will be Acala-type cotton on 12 feddans, Ashfordgroundnuts on 8 feddans and the rest fallow. Plans include the introduction of fruits and vegetable gardens in some of the land.

The scheme is managed by the Rahad Corporation. The Corporation performs a number of functions. It purchases the inputs required by farmers, especially fertilizer, pesticides and spraying service. It also purchases farmers' crops and delivers produce to Port Sudan. It provides a full range of mechanized field operations, including land levelling, planting of crops and harvesting of ground-

nuts. Lately, mechanization included the cotton picking operation. In 1980/81 mechanized harvesting accounted for 25% of the harvest and more mechanical harvesters are planned to be imported. The rest is harvested manually by tenant labour with the help of hired labour. In addition to paying the costs of the above-mentioned services provided by the Corporation, tenants in the scheme pay a fixed "land and water charge". Tenants were given a three years grace period after which the Corporation will levy an annual land and water charge of at least L.S 4 per feddan rising to L.S 7 per feddan within a further four years.

In addition to Gezira and Rahad schemes, other semi public sector schemes manged by State agricultural corporations include Khashm El Qirba and Es Suki Scheme. Khashm El Qirba comprise an area of 450,000 feddans irrigated from a dam constructed at Atbra River, another Nile tributory which descends from the Ethyopian highlands. The scheme was established in 1964 to settle the inhabitants of Wadi Halfa who were displaced by Aswan Dam. The scheme grows medium staple cotton, wheat and groundnuts. Es Suki scheme started in 1970 and grows medium staple cotton and groundnuts in addition to horticultural production in 5.6% of the total area of 89,000 feddans of the scheme.

Agricultural development in the Sudan has also seen the introduction of private pump schemes along the Nile and its tributaries. Significant among these were the private cotton pump schemes in White Nile which started in 1929 and those on the Blue Nile which began in 1949. The 1950's saw a considerable expansion in these schemes brought about by the soaring cotton prices of the Korean boom. Most

of the schemes were held by religious dignitaries and their families as well as by tribal chiefs and wealthy businessmen. Money for investment in the schemes was obtained from the Agricultural Bank of Sudan, which since its establishment in 1959 and up to 1968 was mainly occupied in financing production and marketing of cotton in these schemes (Abdel Salam, 1976). Production in the schemes was governed by a sharing arrangement between the owners and the tenants similar to that of Gezira. In return for 40 per cent of the proceeds from cotton, after deduction of certain costs, tenants carry on certain agricultural operations. These include ploughing and land clearing, sowing of cotton, harvesting, maintenance of canals and clearing of fields. The owners control the management, ginning and marketing of cotton in return for the rest of the proceeds. Sharing of the costs of production was confined only to ginning and transportation expenses while the rest of the cost is shouldered entirely by the tenants.

The private cotton states suffered a number of problems. Due to the decline in cotton prices and production problems which resulted in low yields, the indebtedness of the schemes to the Agricultural Bank of Sudan increased considerably until it became impossible to finance them. In 1968 the schemes were nationalized and an Agricultural Reform Corporation was set up to manage them. The aim of the takeover as expressed by the government was, inter alia, to raise the tenants' income, introduce social services and cooperative movement in the scheme (El Hassan, 1976).

A third landmark in the development of the agricultural

sector in Sudan, beside the inauguration of large semi public schemes and the private pump schemes, has been the introduction of large mechanized farms in areas of rainfed cultivation. The latter are designated as 'The Granary of the Sudan', and lie roughly between isohyet 450-800 mm (Agabawi, 1965). The beginning of rainfed mechanized agriculture dates back to 1943, when the British had started a small project near Qedarif to feed troops stationed in the region. By 1953, the government began to lease large plots to private Sudanese for operation on a commercial basis. This enterprise proved so profitable to Sudanese capitalists that crop areas expanded to 1.2 million feddans within five years. The crops grown are mainly dura, together with sesame and cotton.

In contrast to the irrigated sector, mechanized rainfed cultivation is dominated by private enterprise. Out of a total of 15.5 millions of feddans of rainfed cultivation only 0.4 million feddans are state owned farms (Ministry of Planning, 1979). Moreover mechanized farms are large in size, usually 1000 to 1500 feddans each. The government, however, by virtue of its ownership of land, had a degree of control and supervision over the private schemes. The schemes were distributed at a nominal rent of P.T.5 per feddan mostly to urban merchants, tribal leaders in the Native Administration and some cooperatives. In 1968, the World Bank became involved in rainfed agriculture. It helped set up the Mechanized Farming Corporation (MFC) to supervise rainfed agriculture. Three mechanized farming projects were implemented over the next 10 years with World Bank loans. The Bank also provided loans, administered by MFC, for 75% of the purchase price of tractors (terms to the private operator:

8% per year with five years to repay) (O'Brien, 1978, 1983). Area under mechanized farming has been growing rapidly in recent years. By 1977 this area reached 4 million feddans of regulated projects and a similar area of illegal farming. A goal of 10 million feddans was projected for 1982/83, most of the increase to be financed by loans and direct investment organized through the Arab Authority for Agricultural Investment and Development (Ministry of Planning, 1977).

Mechanized farming has suffered from a number of drawbacks, Much of the development of the sector has been one-sided concentrating ultimately on horizontal expansion of production. No concern is being given to the provision of extension services, credit facilities or the preservation of the soil (Abdel Salam, 1976). In fact it has been argued that mechanized cultivation has led to soil erosion and deprivation of the fertility of rainfed land through extensive cultivation. Prospects of high profits encouraged farm operators to bring all land under their possession into cultivation ignoring the prescribed rotation which stipulates fallow lands in the annual cropping [4/] (O'Brien, 1978). The declining soil fertility has resulted in low productivity so much that

> "yields from mechanized schemes generally fall below what are regarded as acceptable profitability levels within about five to seven years and that schemes rarely remain in continuous cultivation for more than ten years. As a result viewing new expansion of cultivated lands as cumulative is at best misleading, for much of the old land is dropping out of

4/ The MPC however does not say anything about how the prescribed rotation would be enforced or any measures that could be taken against those who do not practice it.

use [unless of course it has been left fallow and re-used]". (O'Brien, 1978, p.4.)

The total cropped areas and output of major crops under both irrigated and rainfed cultivation (mechanized and traditional) for 1977/1978 are presented in Table 1.9.

A total of 16.4 million feddans was under the major crops in 1977/78. Out of this about 14 millions which is 84.3% of the total cropped area was rainfed. Within the rainfed cultivation 73.5% was under traditional cultivation. The latter sector comprises small farms operated by traditional methods of cultivation. These farms are usually run on a family basis to produce largely for subsistence requirements. During peak seasons of cultivation e.g. harvesting, hiring of labour is not unusual. Secondly, the table reveals that most of the rainfed cropped area was under the production of sorghum.

Although the irrigated crops represent only 15% of the total cropped area, their contribution to the total production of major crops is 50%. The high productivity of the irrigated sector relative to the rainfed cultivation reflect the high level of investment in this sector whether in the use of modern techniques in production or the regular application of farm inputs like fertilizers, insecticides and pesticides. Most of the extension and research facilities are also concentrated in the modern irrigated sector.

TABLE 1.9 : Crop area and output under irrigated and rainfed conditions, 1977/78.
(Area in thousand feddans, output in thousand tons).

Crop	Irrigated		Mechanized Rainfed		Traditional Rainfed		Total	
	Area	Output	Area	Output	Area	Output	Area	Output
Cotton (Long Staple)	548	300					548	300
Cotton (Medium Staple)	404	229					404	229
Cotton (Short Staple)			3	1	165	18	168	19
Sorghum	539	268	3087	936	3036	813	6662	2017
Wheat	602	317					602	317
Groundnuts	380	429			2281	600	2661	1027
Sesame			582	79	1767	166	2349	245
Millet					2948	487	2948	487
Sugar Cane	55	1550					55	1550
Horse Beans	42	34					42	34
Total major Crops	2570		3672		10197		16439	

Source: Ministry of Planning, Recent Performance of the Agricultural Sector (Khartoum, 1979), p.10.

Finally agricultural production in Sudan is largely hindered by insufficient credit and marketing facilities. Regarding credit there are two main sources of agricultural credit. (i) the informal sources which include the money lenders, village shopkeepers, merchants, relatives and friends (ii) the formal sources which include the commercial, cooperative and saving banks, Bank of Sudan and the Agricultural Bank of Sudan. The latter is the main source of credit for agricultural activites. Its services, however, are limited to large cultivators. Most of the farmers in the traditional sector resort to the informal sources of credit at high interest rates. As far as marketing is concerned, specialized marketing institutions exist only for marketing of the cash crop cotton and for the oil seeds. The former is marketed through the Cotton Public Corporation while the semi public Oil-seeds Company has the monopoly of exports of thelatter. A large part of the surplus production in the traditional sector is brought to the market through the shop-keepers and merchants who are often the same people who extend the credit facilities.

1.5.2 Livestock

Sudan enjoys an enormous wealth of livestock. No animal census has ever been carried out in Sudan. The published official figures are deduced from vaccination and taxation records. These can be regarded at best as rough approximations which underestimate the true figures. Table 1.10 gives the total estimated livestock in heads for 1977/78.

TABLE 1.10 : Livestock wealth (in thousand heads) 1977/78

Province	Cattle	%	Sheep	%	Goats	%	Camels	%
Northern Darfour	939	5.9	1508	8.7	1277	10.6	231	9.6
Southern Darfour	2831	17.8	1318	7.6	1195	9.9	145	6.0
Northern Kordofan	990	6.1	2664	15.2	180	14.9	869	36.1
Southern Kordofan	1519	9.5	888	5.1	745	6.2	2	0.2
White Nile	1618	10.2	2362	13.6	703	5.8	79	3.3
Blue Nile	931	5.9	1154	6.6	636	5.3	39	1.6
Gezira	522	3.3	1301	7.5	1224	10.1	149	6.2
Upper Nile	1478	9.3	1121	6.5	402	3.3	5	0.2
Bahr El Ghazal	1271	8.0	769	4.4	646	5.3		
Eastern Equatoria	825	5.2	979	5.6	257	2.1	29	1.2
Western Equatoria					21	0.2		
Buhairat	725	4.5	357	2.1	325	2.7		
Jongeli	1454	9.1	186	1.1	493	4.1		
Kassala	665	4.2	1701	9.8	990	8.2	579	24.0
Red Sea	38	0.2	240	1.4	476	3.9	97	4.0
The Nile Province	45	0.3	292	1.7	281	2.3	60	2.5
Northern Province	15	0.1	219	1.3	156	1.3	110	4.6
Khartoum	59	0.4	318	1.8	460	3.8	14	0.6
Total	15905	100	17358	100	12088	100	2408	100

Source: Ministry of Finance and National Economy, Economic Survey 1977/78 (Khartoum, 1978), p.20.

A total of 48 million heads is given in the table. The official statistics give rates of growth of 3.5%, 7% and 4% for sheep, cattle and camels respectively. As the table reveals the livestock wealth is concentrated in the western region of Darfur and Kordofan and in the central region of White Nile, Blue Nile and Gezira. The livestock sector is still largely traditional with only 5% of livestock products being produced under modern facilities. The sector as a whole suffers from the lack of research in animal production. It is also handicapped by shortages of water and poor animal husbandry. Social traditions too play a part in hampering the development of the sector. In the southern part of the country, for example, social values attach prestige to ownership of large number of animals and trade in them seldom takes place: their use being limited to the paymentof bride's dowry in the case of marriage. As a result the livestock sector contribution to GDP has been small though increasing in recent years. In 1975/76 the sector contributed 16% to GDP. This figure has risen to 18% in 1976/77.

1.6 Summary

After the above cursory account of some of the features of Sudan economy we can say the following. Firstly the country is large and thinly populated. The population has been growing at an approximate rate of 2.14 per cent per annum. Most of the population live in rural areas: the proportion of the total population living in rural places in 1973 was 81.5%. The rate of the growth of population in the latter has also been small compared with a considerable growth rate in the urban centres. This can be due largely to migration to urban areas from the rural sides of the country. Secondly the economy

has been growing at an average rate of 3 to 4 per cent. Thirdly, the unstable rate of growth of the economy can be attributed to the dominance of the agricultural sector which contributes two-fifths of the gross domestic product. The majority of the economically active population in this sector are own account or unpaid family workers. Fourthly the government policy toward the development of the agricultural sector has been marked by an emphasis on expansion of irrigated cultivation and large scale mechanized rainfed cultivation. The organization of irrigated agriculture is characterized by the retention of family farms and sharing management with the government. Large areas in the irrigated sector are allocated to the production of primary agricultural products which represent most of Sudan's exports. Among the latter cotton assumes a high importance. Revenue from cotton accounts for two thirds of the foreign exchange earnings of the country. Mechanized cultivation on the other hand has not been accompanied by expansion in some complementary inputs which would increase productivity. The sector suffers from lack of extension services, credit facilities and lack of pest control and use of fertilizers to preserve the fertility of soil. Fifthly, an important aspect of the economy, as far as this study is concerned, is that a large part of the agricultural sector remains the small scale traditional rainfed cultivation. Little is known about this sector in terms of the relations of production and allocation of resources. Possibly because of such ignorance the government has had no defined policies aiming at improving productivity in this sector. The neglect of the rainfed sector (traditional and mechanized) is unfortunate for two reasons. The country's production of staple food grains depends on this sector. Secondly an understanding of the laws governing production in this sector will help in formulation of appropriate policies of agricultural development.

CHAPTER 2 - The Theoretical Issues and the Data

2.1 Introduction

This chapter discusses some of the theoretical issues we will be dealing with in later chapters and the data which will be used in testing these issues. Section 2.2 gives a general review of these issues. Section 2.3 describes the sample of villages we will be using in investigating the points set in 2.2. In 2.4 we describe the collection of data. Section 2.5 gives a picture of the villages; their location, the agricultural year and the distribution of their population by age, sex and by the education level. A conclusion is given in Section 2.6.

2.2 The Issues

Disguised unemployment has been one of the main issues which occupied the writings in development in the 1950's. The central theme was the existence of a pool of surplus labour which could be drawn from agriculture to meet the expanding needs of a small but growing industrial sector. It being assumed that this withdrawal would not lead to a reduction of output in the agricultural sector, that the marginal productivity of labour is zero. These ideas were used in models of the development of the dual economy such as those of Lewis (1954), Ranis and Fei (1961) and Nurkse (1953). In these models labour would be available at a constant wage rate slightly above the average agricultural product and output and employment in the industrial sector would expand through the investment of the profits of the capitalists. The success of such mechanism required a simultaneous

balanced growth of the agricultural productivity such that terms of trade between agriculture and industry would remain favourable to such an expansion. However the proponents of these views had to defend themselves on two fronts. One is theoretical. The other is empirical. Confining ourselves to the former, it was observed that positive wages exist in the agricultural labour market of developing economies, a thing which could not be easily reconciled with a zero marginal product in agriculture.

An early attempt to provide an explanation for this was advanced by Leibenstein (1957). In his analysis he used a functional relationship between the wages and the supply of work units per labourer. According to him labourers in the developing countries are in a poor state of health and nutrition such that at very low levels of wages the amount of efforts is so low that the demand for work units is not met. Accordingly, at low levels of wages a deficit of labour exists whereas higher level of wages through their effect on health and living standards of the worker, induce a greater amount of effort and more units of work being supplied and therefore a surplus of labour is generated. That shortage of labour at low level of wages could ensue was apparently observed in the farms and plantations of tropical underdeveloped countries where the owners complained about the shortage of labour despite the low level of wages which continued to persist (Myint, 1980). Their explanation for this was the poor quality of labour, the bulk of which came from the subsistence sector. Some would complain that even at the low wages paid, the indigenous labour was expensive because its productivity was lower still. Leibenstein went on to show that if employers had to employ all the existing supply in the agricultural sector they would do this at a

wage which exceeds their marginal product. However the assumption of full employment equilibrium at such wage rates seemed to be unreasonable if one had to consider that the employers maximise profit at a wage where the marginal cost of a unit of work is equated to its marginal revenue product. This has been pointed out by Mazumdar (1959).

The functional relationship between consumption and productivity has been taken up in papers by Mirrlees (1976), Stiglitz (1976) and recently by Bliss and Stern (1978). The issues discussed varied between the effect of the relationship in the determination of wages in the rural sector to the employment equilibrium, surplus labour, distribution of consumption within the household, income distribution and shadow prices. Confining ourselves to the first issue for the moment, the employer is assumed to be a profit maximizer:

(i) who can hire as much labour as he can at a given wage rate $\bar{w}$.

(ii) He knows that paying a higher wage improves the efficiency hours of labour time as given by the function $h(w)$, $h' > 0$.

(iii) All wages are consumed : $w = c$

(iv) Output price = 1.

Assume a fixed number of hours worked per worker, ℓ the number of workers, $h(w)$ are the efficiency hours of labour produced by one clock hour and the number of efficiency hours produced is $\ell h(w)$. Output depends on the efficiency hours produced by

$$y = f(\ell h(w))$$

The Model

$$\max_{w,\ell} \Pi = f(\ell h(w)) - \ell w$$

or

$$\max \Pi = f(\ell h(w)) - \ell h(w) \frac{w}{h(w)}$$

The problem can be broken into two parts

$$\text{First} \quad \min_{w} \frac{w}{h(w)}$$

$$\text{Second} \quad \max_{\ell} \Pi$$

which is equivalent to

$$\min_{w,\ell} \; w\ell \quad \text{s.t.} \quad f(\ell h(w)) \geq \bar{y}$$
$$w \geq \bar{w}$$

Forming the Lagrangian multiplier, the F.O.C.'s give:

$$w/h = 1/h'(w) \qquad (1)$$

This says that the average cost of an efficiency hour is at equilibrium equal to the marginal cost. The wage which solves

(1) is referred to as the efficiency wage. The relationship between efficiency hours and consumption and the equilibrium wage W^* are shown in Figure 2.1.

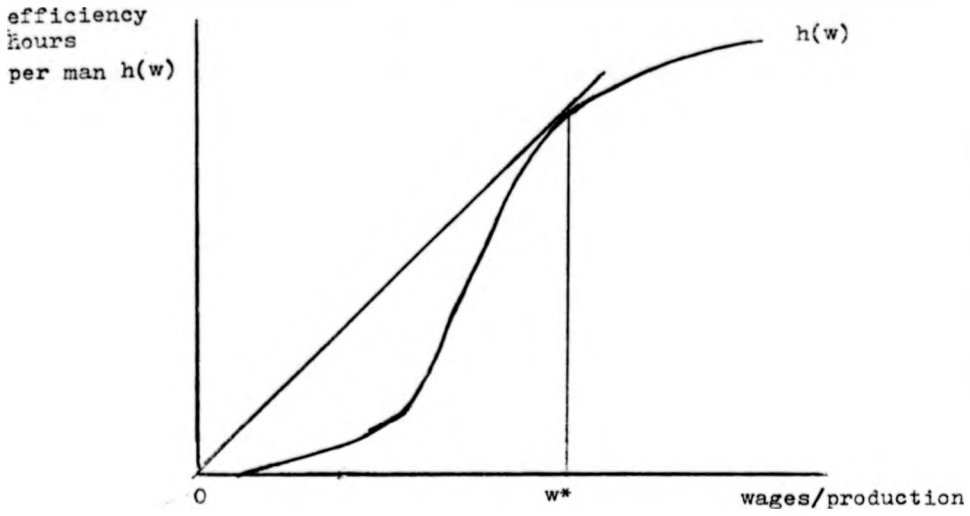

FIGURE 2.1

A suggestive feature of the above model is the emergence of an efficiency wage w^* which employers will choose to pay, independent of the conditions of labour supply, to all workers with no alternative source of consumption. And if one is ready to assume that h(.) is invariant across regions and seasons and under different techniques and conditions of production, then this wage will be the same across regions and for different production conditions. At any rate one reason why h(.) may be variant is that different kinds of work demands different physical activities. Another implication of the theory is that because the effect of consumption in productivity tends to manifest itself over the long run, one would expect long term

contracts to prevail. For the same reason permanent farm servants are expected to be paid more than casual labourers.

We should note that the significance of the efficiency wage relationship depends on the elasticity of efficient hours with respect to the wage rate. In other words, as long as the increase in the wage results in more than a proportionate rise in the efficient hours produced it pays the employer to do so. It is apparent that at w^* the gains to the employer are just offset by the wage payment. At w^*

$$\frac{h'(w^*)}{h(w^*)} \quad w^* = 1$$

and the average cost of an efficiency hour reached a minimum. For $w < w^*$ it would be beneficial for the employer to increase the wage as

$$w\, h'(w)/h(w) > 1$$

and the average cost per efficiency hour will be declining. Now if all the workers were employed at a wage rate below w^*, dictated by the competitive forces of the market we can see that the original units of work could be done at a lower wage bill with fewer number of workers paid at a higher wage. A similar result obtains for an egalitarian peasant economy where output is divided equally among its members. As shown by Stiglitz (1976), with each member's share equal w, we will have

$$w = f(\ell h(w))/\ell \qquad (2)$$

Taking logs of both side and differentiating, after some manipulation

$$\frac{d\ln f}{d\ln \ell} = \frac{\alpha\left(1-\frac{h'w}{h}\right)}{1-\alpha\frac{h'w}{h}} \gtreqless 0$$

according as

$$\frac{h'w}{h} \lesseqgtr 1 \quad \text{i.e. as} \quad w \gtreqless w^* \qquad (3)$$

where $\alpha = \frac{f'\ell h(w)}{f}$

The inequalities in (3) have the interesting implications for the poor peasant economy that as long as consumption levels are below w^* any increase in the number of workers would have a negative effect on output. Conversely, if some of the population left the farm each remaining member's share will increase and with $h'w/h > 1$ there will be a positive effect on labour productivity.[1/]

1/ A different way of looking at (3), is that the social marginal productivity is negative in the rural areas, albeit the private marginal productivity f' is not zero; each person is contributing something on the margin to productivity. It is only his presence in the rural sector that decreases the per capita income and hence productivity of other workers in that sector which makes his social productivity negative. (Stiglitz, 1976).

The introduction of efforts expended at work as distinct from the physical units of labour as the determinant of work output has proved to be useful and showed that more insight could be gained through its utilization in the treatment of resource allocation by peasant's households. In the paper by Sen (1966), assuming that the peasant family maximizes a welfare function which is a linear combination of the individual utility of consumption and the individual disutility of work, it was made clear that though the marginal productivity of labourers in agriculture could be zero, the marginal productivity of labour would not. With the distinction between the working members in the family and the work effort put on by each member being introduced, non decline of output following a removal of workers from the farms, that is surplus labour, would be possible if certain assumptions hold between marginal utility and marginal product. A peasant household who is behaving as a utility maximizer tend to supply labour up to the point where the marginal rate of substitution between leisure and income is equated to the marginal returns from effort, the standard microeconomic result. The only way, therefore, surplus labour could exist in such an economy was to assume a constant marginal rate of substitution between work effort and income . .

In terms of Sen's model then, the possibility of a surplus emerges also if one assumes that due to the low standards of living the disutility of efforts is inversely related to consumption of the household and hence a decline in the marginal utility of income which results from the rise in the member's share of the product would be offset by a compensating decline in the marginal disutility of efforts leaving the equilibrium solution unchanged.

Sen's model (the version presented in Sen (1975)) was analyzed by Bliss and Stern (1982) placing particular emphasis on the implications of the organizational structure of the family farm for the allocation decisions of peasants family. Assume that the peasant family has a fixed amount of land available at its disposal. The family working members N share the total amount of work L equally with each member's share equal $x = L/N$. The individual member usually obtains an equal share of output Y which is a function of $L, f(L)$. The individual, however, places a value k on output going to other members of the family. The utility function for the individual is such that individual disutility of labour can be measured in terms of consumption as a function of x only written $S(x)$. The individual solves the following maximization problem

$$\max_{x} \; ((\alpha + (1-\alpha)k)Y - S(x))$$

In maximizing his utility function the individual member takes the labour input of other members as given. Thus although labour is equally shared at L/N each, he is trying to decide whether to do any more himself assuming that the other's labour input remain constant: $Y = f(X+x)$ where X is the work of others and $L = X + x$. The equilibrium solution is

$$S'(L/N) = k_o f'(L) \qquad (4)$$

where $k_o = \alpha + (1-\alpha)k$, and is shown in Figure 2.2.

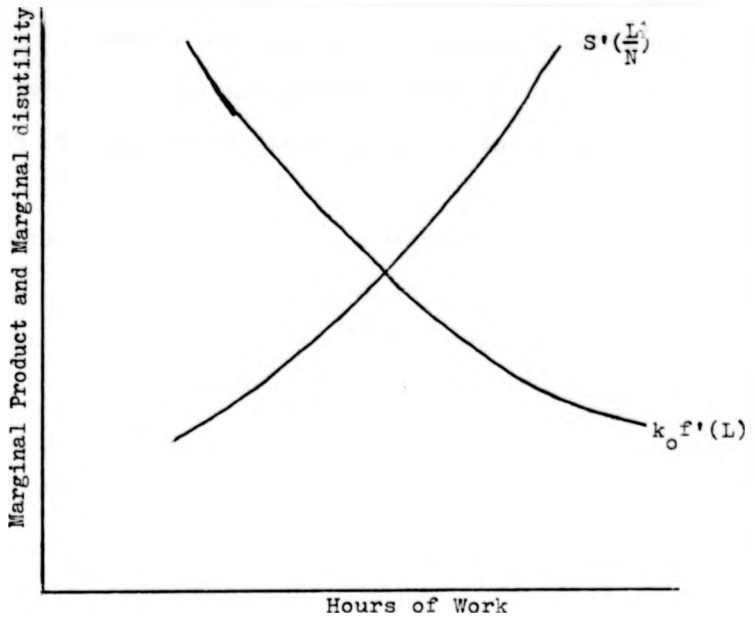

FIGURE 2.2

The equality in (4) says that the individual applies work up to the point where the cost of an additional unit of work given by the marginal disutility of work is equated to k_o times the marginal product of labour f'.

Whether total labour L and hence output Y will change when total number of people N change will depend on whether k_o is independentof N. k_o will be independent of N only if $k = 1$, and then $k_o = 1$, since α will usually depend on N. In this case $S'(L/N) = f'(L)$. Assuming α decreases with N, $S'' \geq 0$ $f'' < 0$, and $k < 1$, a decrease in N will have the effect of

shifting the S' curve up and to the left and the $k_o f'$ curve up and to the right. The effect on L is ambiguous except for two cases: (1) $k_o = 1$, when a decrease in N implies a reduction in L and hence output; (2) constant marginal disutility S', in which case a decline in N implies an increase in L and output.

The equilibrium condition $S'(L/N) = f'(L)$ can be derived in an alternative way if the assumption is made that the family takes both the output and labour allocation decision together. Assuming that the family

$$\underset{x}{\text{Max}} \quad \Sigma U(c,x) = \Sigma c - \Sigma s(x)$$
$$\text{s.t.} \quad \Sigma c \leq f(\Sigma x)$$

where c is consumption of an individual and the sum runs over the family members N. Assuming that the constraint binds the first order conditions give $S'(L/N) = f'(L)$. Bliss and Stern referred to the case when $S' = f'$ as the optimally organized farm. The above results were summarized as follows:

Table 2.1 : Behaviour of total labour input when the number of individuals in the family farm decreases

	Constant marginal disutility labour	Increasing Marginal disutility labour
Optimally organized farm $k_o = 1$	L = constant	decreases
"Inefficient" Farm $k_o < 1$	increase	change in L ambiguous

In the above model the distinction between work efforts or labour and the physical units of labourers has been clearly brought out. The case of equilibrium L being independent of N gives zero marginal product of labourers but not of labour.

In the above discussion we have expounded some of the issues and theories which are relevant to the labour markets of poor peasant society. Some of the hypotheses advanced here regarding wage determination will be examined in Section 3.3 to see if they could be supported by the set of data which we have collected. In Chapter 5 in an analysis of output determination a production function will be estimated for a group of farms in which labour input will be measured in number of hours of labour. The magnitude of marginal productivity and the efficiency of labour utilization will be assessed. Agriculture, however, is characterized by seasonality where demand for labour input differs across the season, being high during the peak season of agriculture, e.g. harvesting and threshing and low in other seasons giving a slack period in the employment opportunities for labour. This distinction will be introduced in the analysis and the marginal productivities of labour in both the busy and slack season will be estimated.

An important issue which has attracted much attention on the recent literature on labour markets in poor countries is the migration decision, particularly rural-urban migration. In the models which dealt with rural-urban migration, the individual's decision whether to migrate or not was based on a comparison between the rural wage or utility level and the expected urban wage or expected utility level. An exposition of the main issues and theories of rural-urban migration will be carried out in 7.2. A migration function for the villages

will be postulated in 7.5 and an empirical examination will be carried out. The consumption patterns of rural households and the allocation of the family's total outlay among different expenditure items will also be examined. An underlying assumption of the relationship between wages or consumption and output in efficiency terms in the preceding account is that labour is poorly fed in low income countries. Raising the income level of peasant's households or the wage payment of workers is thought to have a beneficial effect on the stock of human capital. It would improve the health and vigour of the working populace and would be conducive to productivity and output. An implicit assumption is that all income or wages are consumed. In addition the relationship does not address the question of how increases in earnings should be allocated to food baskets that have more nutritious value than the ones used. Households may continue to derive the calorific requirement of their bodies from the same source of food despite income increases by way of habit, presence of food taboos or merely because of ignorance of value of consuming better food varieties. The planning decisions by the government in the field of agricultural development, the allocation of newly improved land among the agricultural produce and provision of extension services, new technology in the form of better seeds, application of fertilizers and insecticides are all of vital importance in these matters.

An approach which was followed in studies which took account of the consumption productivity relationship is to look at the calorie intake of people in certain occupations or sections of the populations and compare them with the so-called requirement for the particular activities in which they are employed. When the intake fell short of the requirement it would be inferred that the standards of living

were so low that the efficient utilization of the labour potential of people was duly affected. Alternatively some studies have tended to use the above approach to look at the number of people whose income fell below a minimum thought to be enough to satisfy the required amount of diet necessary in terms of calorie and protein. A study in the latter spirit was carried out by Bardhan (1973a) for rural India for 1960/61 and 1968/69. Bardhan finds that the proportion of the "rural poor" has risen from less than 38% in 1960/61 to about 54% in 1968/69. Another study for a large number of poor countries was carried out by Reutlinger and Selowsky (1976). A criticism which is levied against these studies is that calculations of these sorts are very sensitive to small increases or decreases in the amount of calories which one assumes to be the right magnitude required. This is especially true when the phenomenon of adaption by the body is realized and incorporated in the calculation of the requirement, for then adjustment upward or downward may be necessary. The idea of adaption by the body relates to the mechanism by which the body adjusts to low calorie intake by slowing down the pace of activities. Another important fact which is not taken care of in these studies is seasonal fluctuations in the requirement of agricultural population, a matter which is directly connected with the concept of the body as a store of energy and the adjustment to the level of seasonal activity through increases or decreases in body weight.

A detailed analysis of diet in Gezira and in two villages on the eastern bank of the Blue Nile was taken up by Culwick (1951). After a comprehensive quantitative assessment of food consumption she concludes

> "... the general average (of food consumption) is at a level which results in low weights, low average output of physical energy, an inclination to intermittent bursts of energy rather than sustained activity, low general efficiency and altogether a slow rate of living" (pp.145-146)

Culwick ended up by suggesting two types of diet, A and B, for a family composed of six persons. Diet type A was meant to be as an intermediate step towards the more improved type B. Both model A and B are intended to be a flexible pattern which could adapt easily to seasons and circumstances. Culwick made calculations of the total cost of both diets at 1950 price (p.149). The cost of improved type diet B was estimated in 1977 by Taha (1977, p.100). In Section 4.4 a consumption function will be estimated which would allow calculation of the minimum perceived subsistence expenditure on food by rural households. A comparison of minimum subsistence outlay on food by families with the total cost of improved type B diet will be carried out there.

An issue which lies at the heart of production efficiency of traditional agriculture is the relationship between the size of cultivated farm and output per cultivated unit. The question is relevant for economic policy issues like land reform, land redistribution and cooperatives. It has important implications for the mode of employment and the question of choice of techniques for the agricultural sector. The relationship has been studied in a number of papers pertaining to Indian agriculture.

The debate on the relationship between size of farm and productivity started when on the basis of size class averages, Sen (1962)

made an observation that there was an inverse relationship between size of farm and output per acre. However, Sen was aware that the relationship could be a statistical illusion arising from some kind of averaging bias. He, therefore, made it obvious that further inquiry is required if observation is to be substantiated. A number of papers then followed in an attempt to establish the statistical validity of the relationship. This time evidence was sought on the basis of individual farm level data. In fact in the early days of the debate much effort was spent in improving the data base on which a statistical test could be carried out. For example, Rao (1967), after exclusion of fallow land from size of holding provides evidence that output per acre remains constant as farm size increases. Saini (1971) provided evidence in support of the relationship. His paper was considered important because it used disaggregated farm level data from nine states in India. Saini also made a test of returns to scale in Indian agriculture using the same set of data. He found that Indian agriculture is characterized by constant returns to scale. Evidence made by Bhattacharya and Saini (1972) provided further proof of the inverse relationship between size of farm and productivity. Bardhan (1973b) also found evidence for some of the districts in India. It seemed that the inverse relationship between size of farm and output per acre holds at the wider level, i.e. for data from different villages. In a recent study of four villages from Pakistan, Nabi (1981) found that the relationship also holds for data from each village.

Sen (1964) sought an explanation for the relationship in terms of the dualistic nature of labour markets in rural areas. Identifying small farms with family operated farms, he argued that small farms apply more of the cheaper family labour to an acre of land

and hence get more output per acre of land than big farms. This implies that small farms use labour up to the point where marginal product falls short of the wage rate. Another possible explanation given by Sen was that small farms are endowed with superior qualities of land as compared to large ones. Mazumdar (1965) seemed to agree with the first explanation. According to him higher output per acre in smaller farms is a function of higher input of labour per acre while the other factors vary more or less in the same proportion as labour. Saini (1971) gives weight to Mazumdar's argument as an explanation of the statistical results which he obtained. However, Bardhan (1973b) using farm level data found that the marginal product of labour exceeded the wage rate which could be taken as evidence against the labour-cost explanation which purports that the low opportunity cost family labour will be used to the point where its marginal product falls short of the wage rate. Bardhan at any rate was aware that his estimate of the marginal product could be including part of the effect of some of the variables which were excluded from the regression, e.g. bullock labour and hence was biased upward.

On the other hand, Sen's second explanation needs to elucidate why small farms would have higher quality of land than large ones. Sen offered some demographic explanation. According to him population tends to concentrate at places where land is most fertile. As time passes, with population pressure the land gets subdivided through inheritance laws or sales. Bhagwati and Chakravarty (1969) argue that in times of distress farmers tend to sell infertile pieces of land, keeping fertile parcels for themselves. This results in large infertile parcels of land being acquired through market sale. Bhagwati and Chakravarty however do not explain why land owners would sell pieces

of land of inferior quality and not some of the good fertile land.

In Section 5.4 we test the hypothesis of the inverse relationship between size of land cultivated and output per feddan for data from within villages and for different groups of villages.

Land is certainly the most important factor of production and income generation in rural areas. The subject of land distribution and inequalities in land ownership was a recurring theme in development economics. Distribution of land will be examined. An important topic which relates to land is the tenurial arrangement in the agricultural sector. The efficiency of fixed rent contracts versus share cropping arrangements is the subject of Section 6.2. In connection with land markets we will be interested in examining the factors which determine the demand for land. A model proposed by Bliss and Stern (1982, Chapter 5) will be tested. In this model net land leased in (land leased in minus leased out) was seen to occur in an adjustment process of land owned toward a desired cultivated land which in turn is a function of factors that are not perfectly marketable. It will be argued in Section 6.4, because of some characteristics of agricultural cultivation for the sample of villages we have, that the number of working adult members in the family enters into the determination of desired cultivated land and hence is an explanatory factor of the demand for land (net land leased in) by the household.

While labour represents an important source of input and motive power in agricultural activities in rural areas, in some places the nature of agricultural cultivation is undergoing a substantial change with the introduction of new technology. In our sample of

villages, mechanization of farms, particularly in ploughing and sowing, is widespread. Mechanized power which is hired from the few owners of tractors in the villages and from outside the villages is becoming increasingly demanded. The decision to mechanize may be in response to changes in the relative prices of inputs - more capital services will be hired as labour becomes more expensive, or to a shift in the production function which increases the marginal productivity of machinery. The effect of mechanization may be to allow farmers to use their existing resources more intensely, change the timing of farm operations, increase the size of their farms and change the composition of labour units.

The extent of farm mechanization will be examined. Whether farm mechanization will or not induce farmers to increase the size of their farms by hiring in more land will be tested in Section 6.4. On the other hand, the effect of farm mechanization on the decision to migrate will be tested in Section 7.5.

2.3 The Sample

The data which we are going to use to examine the issues set in Section 2.2 is from two sources. One is derived from the returns of the Household Budget Survey which was undertaken by the Department of Statistics in Sudan. Work on the survey was started in June 1978 and finished in May 1979. The information on household budgets was collected from the different provinces in Sudan by direct interviewing of heads of households for twelve months and recorded for every week in the month. The questionaire used in getting the information was a detailed one and included the various

aspects in household expenditures in different items of consumption and origins of income. For our purpose of the study of consumption patterns and expenditure elasticities the product of the survey happened to be an appropriate report.

Although the statistics provided by the survey are comprehensive and encompass many details there are other areas which were of interest to us that were not contained. These included the statistics on production of agricultural goods, inputs used in output and their utilization in the production process and patterns of migration in the household unit. For this reason the Household Budget Survey was inadequate by itself to offer us all the necessary data that was required in the analysis of the various issues that we want to treat. This has led us to collect our own data for the analysis of markets and production in rural areas.

For the analysis of consumption a sample was chosen from the Household Budget Survey 1978/79. The sample is selected from the population of families who are residents in the rural areas of three provinces. These are Blue Nile, Gezira and White Nile Province (Central Region). From the total of 599 families recorded, 200 were selected using stratified random sampling. The families were located in twenty seven villages in the area. Fourteen of these are in Gezira, six in Blue Nile and seven in White Nile. The fourteen villages in Gezira are distributed more or less evenly across the six administrative groups of the Gezira Scheme.

Our own data are gathered from five villages based on the Rahad area, north of the Rahad Scheme. The villages are Umshaniq-

Ibrahim,[1/] Tamari, Tebeib, Wad-el-Kashif and Meallyab. The economy of the villages is dominated by the cultivation of dura, the staple food crop of the majority of people in rural Sudan. A sample from the villages was selected randomly using the lists of households in the villages which were kept by Village Councils. The lists included the names of household heads and the number of persons in each family and were prepared to be used for the distribution of scarce food materials like sugar which is provided in quotas by the government for each village. Care was taken to purify the lists from errors and mistakes and to update them by checking with the heads of Councils in each village. A total of 152 families was chosen from all the villages.

2.4 The Collection of Data

The data are collected by direct interviewing of heads of households. A detailed questionaire was prepared for this task. We collected data on (i) household's composition : family members including relation to head, age, sex, marital status, education, occupation andplace of residence. (ii) land : own land cultivated and land leased in and the terms of contract, total land ownership and land leased out and left fallow. (iii) the physical quantities of output including the by-products, amounts sold immediately after harvest and the prices. (iv) Non-agricultural income from occupations beside farming and income from sale of livestock and its product. Income remitted from migrant members and relatives also recorded. (v) number of days put by family members who participated in family farm during the agricultural season (land preparation, ploughing, sowing, weeding, harvesting and collection of product) and the number of hours worked. (vi) labour hired-in in different

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1/ Whenever we use the name Umshanlq we will mean Umshanlq-Ibrahim.

seasons and payment. (vii) labour hired out and payment. (viii) tractor hire and cost. (ix) cost of other factors like seeds, sacks and transport of product from field. (x) animals owned, their total value and cost of animal fodder. (xi) Value of animal products, milk in ratols and estimated at village market price. (xii) data on consumption expenditure on food per week and annual expenditures on furniture, cloth and footwear, housing, education and transport. (xiii) credit (shail) during the agricultural season.

The data were collected with the help of Ahmed Taha of Gezira University. During the period of fieldwork we made our stay in Umshaniq with the family of Dr. T.M. Nur of Gezira University, who kindly provided for all our needs. Before the inception of work on the questionaire and in the early days of work on the data on population of the villages we made every attempt of making ourselves known to the people and gaining their confidence by explaining the reasons behind our probing in their private life. During the period of data collection, the evening gatherings in the compartment provided for our accomodation and our acquaintance with the people who used to come and see us gave us an opportunity for informal talks and discussions that enabled us to learn more of the social, economic and historical background in the area. This has helped us to form better judgements and permitted much insight into the activities and economic motivations of the people. Similar gatherings were also held in the other villages in the shaykh's houses. In spite of the fact that the questionaire required hours to complete, and more than one visit to

the family, the people were quite willing to sit and answer our questions and showed a great deal of response, patience and cooperation.

2.5. The Villages

2.5.1. Location

The villages lie between lattitude 14° 45' and 14° 30' N and Longitude 33° 30' and 33° 45' E. Down to the south of the villages and about 33 kilometers from Umshaniq, and on the west bank of Blue Nile one encounters Wadmedani, the biggest town in Blue Nile with a population amounting to 20.6% of the total populations of towns in the Province. A daily bus service links the villages with the town. Northward and 28 kilometers from Umshaniq we find the town of Rufa'a on the east bank of Blue Nile and connected with El Hasaheisa on the other side of the river by a ferry service.

2.5.2. The Agricultural Year

Dura is cultivated either by tractor or through the traditional methods of cultivation. Some families used the tractor on as much land as it could afford and simultaneously tilled as much land as possible using the traditional methods. The richer ones hire tractor for all their land. In the traditional method ploughing, sowing and threshing are done manually with the aid of simple tools like the digging hoe (Torea), the sowing stick (Seluka), earth scoop (Wasuq), weeding hoe (Malod) and the sickle (Mungal).

The agricultural season is as follows. Rains start to fall around June. By mid-July there are heavy rains reaching its maximum in August. In September rain becomes less in quantity dimishing

further through October. In November and December it becomes dry. Table 2.2 shows the average quantity of monthly rainfall in Rufa'a.

Table 2.2 : Average Monthly Rainfall (in millimetres) in Rufa'a: Lat. 14° 45' N and Long 33° 22' E.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Average*	0	0	0	2	11	25	93	108	50	20	0	0

* Average rainfall is calculated from statistics goind back from 5 to 50 years.

Source: Department of Statistics, Internal Statistics : 1967 (Khartoum, 1968), pp.65-66.

Preparation for cultivation usually begins before June and for those who depend on their manual power in ploughing and sowing they may assume building the terraces, clearing and land levelling in May. Some people may leave some of the land fallow. In our sample only a few people did so. The reason for this practice in rainfed cultivation areas in general is to leave the land rest and regain fertility through the growth of vegetation during the rainy period. We do not have information on past cropping patterns in the villages though we know that the year preceding our survey was a year of bad rains and people did not cultivate so much.

By the end of June or mid-July the land will be ready for sowing and some people may have already sown their plots. During August and September people will be undertaking the task of weeding.

In September also people would start picking the wild okra trees which grow in their fields among the dura plant. The growth of the plant is controlled during the early days, when land is being prepared for cultivation of dura. The farmer who is interested in the okra crop would make sure not to knock all the plant away when he was ploughing his farm. This task however becomes difficult with the use of tractors for ploughing as it knocks down the plant in the process. It is partly for this reason that some farmers would limit the use of tractors to only part of the cultivated plot and use traditional methods in the rest of the land.

In October the pace of work will have slackened a bit and women and young members of the household will be proceeding with the collection of okra which they have already started to do by mid-September.

The month of November will be spent in harvesting and December in cutting the sorghum straw which is used to feed animals. Table 2.3 gives a rough picture of the agricultural cycle we have just described.

Table 2.3 : The Agricultural Seasons in the Villages

June - Mid July	Clearing, Land Levelling and Terracing
Mid July-End July	Ploughing and Sowing
August-September	Weeding, okra collection.
October	Weeding and okra collection continues.
November	Cutting and Threshing
December	Sorghum Straw Cutting

2.5.3 Population

Table 2.4 gives the distribution of population for the sample of 152 families by age and sex groups. The table shows that 44.8% of the total population is under 16 years of age. This suggests that the population in the area is very young. This is consistent with the population distribution revealed in the 1973 Population Census which showed that about 47.6% of the population in rural Sudan is under 15 years of age. On the other hand the number of people who are 61 years and above constitute about 4.3% of the population in our sample. The 1973 Census shows that 4.8% of the total population in rural Sudan are sixty years of age and over. The first feature of the population structure in the villages indicates that fertility must be rather high. The low proportion of old people implies that mortality rates are high and life expectancy is low. The population structure also reveals that there are more males who are six years old and less than there are females. However there are more or less equal number of the sexes in the age range 7-16. A considerable imbalance is reflected in the age group 22-31. These can be explained by migration

Table 2.4 : Distribution of Population by Age and Sex in the Sample

Age Group	Males	Females	Total
≤ 6	94 (10.7)	67 (7.6)	161 (18.3)
7-12	70 (8.0)	61 (6.9)	131 (14.9)
12-16	47 (5.3)	55 (6.3)	102 (11.6)
17-22	30 (3.4)	44 (5.0)	74 (8.4)
22-31	37 (7.2)	97(12.0)	134 (15.2)
32-41	59 (6.7)	74 (8.4)	133 (15.2)
42-51	28 (3.2)	33 (3.8)	61 (6.9)
52-61	24 (2.7)	22 (2.5)	46 (5.2)
61+	25 (2.8)	13 (2.5)	38 (4.3)
Total	414 (47)	466(53)	880

Figures in Parentheses are percentage of total.

Table 2.5 : Distribution of Population in the Sample by Age and Education Level

Age Group	No Schooling	Khalwa	Primary	J. Secondary	H. Secondary	More than H.S.
7-11	45	-	86	-	-	-
12-16	24	-	64	14	-	-
17-21	29	-	28	8	8	1
23-32	87	2	36	6	2	1
32-42	115	8	7	2	1	-
42-51	52	10	-	-	-	-
52-62	39	5	1	1	-	-
+61	33	4	1	-	-	-
Total	423	29	223	31	11	2

Notes: J. Secondary : Junior Secondary.
H. Secondary : High Secondary.
Khalwa : Religious informal education

of men in this age group to urban areas. The phenomenon of rural urban migration will be dealt with in a separate chapter. For the moment we note that 13.3% of the total population are males in the age group 7-16. By the age of 15 or 16 some of those who entered school would have finished their junior secondary education. As will become clear later, education appears as one important factor in the determination of decisions to migrate to urban areas. Thus it is probable that some of the 15 year old males might leave the villages in the future which would represent not an inconsiderable proportion of the total population.

Table 2.5 sets out the distribution of population of seven years of age and over by age and education level. The table reveals that about 48% of the population of seven years and above had no schooling. This is a lower figure compared with the figures in the 1973 Population Census of 75.4% and 64.1% for rural Sudan and rural Blue Nile respectively. This is due to the spread of education in the area as reflected in the number of schools in the villages where each village had its primary school, which sometimes takes pupils from surrounding villages as well, beside the existence of Junior Secondary Schools in some of them.

2.6 Conclusion

In this Chapter we have given a general review of some theoretical issues and expounded some topics which we would like to test and which we think would aid us in understanding the working of the economy of rural Sudan. The sample on which these issues are going to be studied and the process of data collection was described

In the following chapters a statistical analysis of the data will be provided.

CHAPTER 3 - Markets in the Villages

3.1 Introduction

This chapter describes the markets for factors in the villages. We start in Section 3.2 with land. The distribution of land holdings will be examined first. Then we proceed to look at the distribution of cultivated land. The analysis in this section will reveal some of the features of land hire. In Section 3.3 we look at the market for labour. Modes of payments of labour and some hypothesis about the determination of wages that were discussed in the preceding chapter will be examined. The market for hire of capital services is described in 3.4 and 3.5 describes the credit market. Some concluding remarks are given in Section 3.6.

3.2 Land

The distribution of land holding is given in Table 3.1. As shown in the table some 43 per cent of the families we surveyed owned only 6.25 per cent of the total land. The number of landless families in the sample is 43 which amounts to 28 per cent of the families in the sample. On the other hand 2% of the families acquired a plot of land more than fifty feddans in area, their total area of land adding to 13.4% of the total.

It seems thus that there is a high degree of land concentration in the villages. This is not surprising in view of previous findings of land distribution in the Rahad area. Table 3.2 gives distribution of land holdings in Rahad region revealed by a census in 1968. As

Table 3.1 : Size Distribution of Land Holding in the Sample

Area	No. of Households	per cent of Total	Area	per cent of total
≤ 5.5	66	43.4	107	6.25
5.5-10.5	38	25.0	354	20.68
10.5-15.5	14	9.2	200	11.68
15.5-20.5	14	9.2	273	15.95
20.5-30.5	9	5.9	241	14.08
30.5-40.5	6	3.9	217	12.68
40.5-50.5	2	1.3	90	5.26
+50.5	3	2.0	230	13.43
Total	152	99.9(1)	1712	100.01(1)
Gini Coefficient = 0.573				

Note: (1) Figures may not add exactly to 100% because of rounding errors.

(2) The unit of land/measurement is the feddan.

Table 3.2 : Distribution of Land Holding in Rahad Area

Area	per centage number of people	per centage of Area
≤5	27.3	11.0
5-10	29.3	15.1
10-25	27.0	27.5
25-50	13.5	27.5
+50	3.6	24.2

Source: Department of Statistics, Agricultural Census in Rahad Area (Khartoum, 1968), p.6.

Table 3.2 indicates, the bottom 56.6% of the people in the region used to claim 26.1% of the land while at the top those who owned more than fifty feddans (3.6%) had 24.2% of the total.

Table 3.3 gives the distribution of land cultivated in the villages. The distribution demonstrates that about 57% of the population had operated about 29% of the cultivated land. On the other hand 4% at the top appropriated some 15.5% of the cultivated land. Thus land cultivated exhibits less inequality than land owned. This is made possible by the presence of a market for renting land and in some instances land transfers among relatives. Movement up or down the distribution structure via leasing or by leaving land fallow can be seen as an example from the number of people who cultivated more than 50 feddans. Previously there are three persons who commanded more than fifty feddans (see Table 3.1). The total area which belonged to them is 60, 70 and 100 feddans. Only the latter cultivated all his land holdings. Of the other two, one leased out 15 feddans and left 25 fallow. This put him with those who cultivated 30.5-40.5. The other leased out 20 feddans and moved to class 40.5-50.5.

A summary measure of inequality of land distribution in Table 3.1 and 3.3 is provided by the Gini coefficient (Sen, 1972, p.31), which appears at the bottom of each Table. The Gini coefficient is defined as

$$G = 1 + \frac{1}{h} - (2/n^2\bar{H})\left\{H_1 + 2H_2 + 3H_3 + \ldots + n\,H_n\right\}$$

where n is the number of individuals, H_i is the size of holding of

Table 3.3 : Size Distribution of Cultivated Areas in the Sample

Area	No. of Households	per cent of Total	Total Area	per cent of Total
≤ 5.5	31	20.4	130	5.94
5.5-10.5	56	36.8	514	23.50
10.5-15.5	22	14.5	312	14.27
15.5-20.5	20	13.1	392	17.92
20.5-30.5	10	6.6	252	11.52
30.5-40.5	7	4.6	249	11.39
40.5-50.5	5	3.3	238	10.88
+50.5	1	0.7	100	4.57
Total	152	100	2187	99.99
Gini Coefficient = 0.384				

individual rank i $(H_1 \geq H_2 \geq H_3 \ldots \geq H_n)$ and $\bar{H}$ is the average size of holding. The Gini coefficient is calculated as 0.573 and 0.384 for land holding and cultivated land respectively. In Figure 3.1 the Gini coefficient represents the area between the Lorenz curve and the 45° line as a proportion of the area below the 45° line.

The distribution of land holding in each of the villages is given in Table 3.4 to 3.8 with calculation of the Gini coefficient at the bottom of each table. From the tables we can see that the lowest Gini coefficient is for Umshamiq while the highest of 0.71 is that for Wad-el-Kashif. The latter village is characterized by the presence of large number of landless families. The proportion of landless families in the sample from the village amounted to 50 per cent.

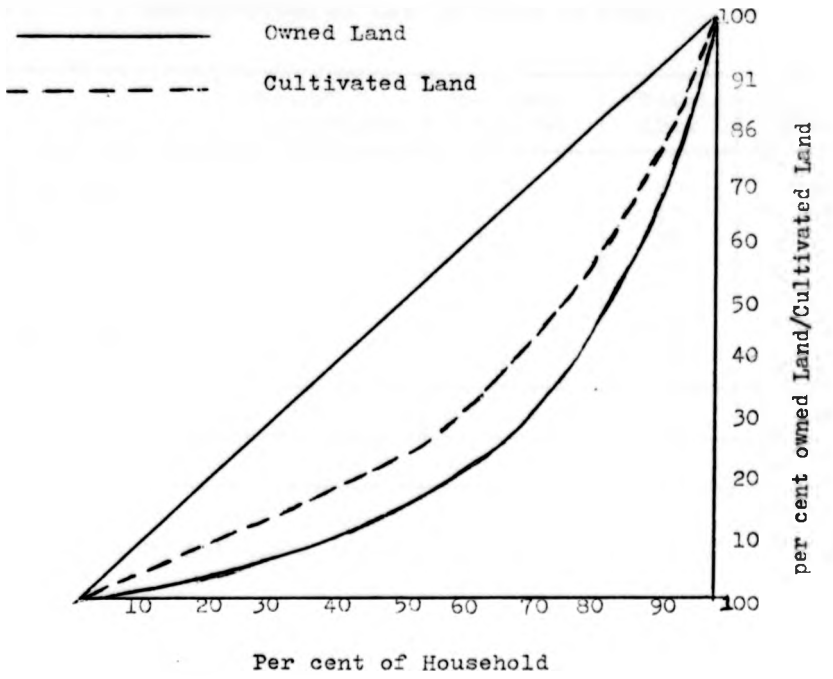

FIGURE 3.1 : Lorenz Curves for Owned and Cultivated Land

Table 3.4 : Distribution of Land holding in Tamari

Area	No. of Households	per cent of Total	Total Area	per cent of Total
30.5-40.5	2	4.1	73	16.01
20.5-30.5	3	6.1	73	16.01
15.5-20.5	7	14.3	133	29.17
10.5-15.5	5	10.2	71	15.57
5.5-10.5	8	16.3	74	16.23
Less than 5.5	8	16.3	32	7.02
Landless	16	32.6	0	0
Total	49	99.9	456	100.01
Gini Coefficient = 0.556				

Table 3.5 : Distribution of Land holding in Tebeit

Area	No. of Households	per cent of total	Total Area	per cent of total
More than 50.5	1	3.1	60	13.51
40.5-50.5	2	6.3	90	20.27
30.5-40.5	1	3.1	35	7.88
15.5-20.5	3	9.4	60	13.51
10.5-15.5	5	15.6	71	15.99
5.5-10.5	12	37.5	108	24.32
Less than 5.5	4	12.5	20	4.50
Landless	4	12.5	0	0
Total	32	100	444	99.9
Gini Coefficient = 0.468				

Table 3.6 : Distribution of Landholding in Umshaniq

Area	No. of Households	per cent of Total	Total Area	per cent of Total
More than 50.5	1	5.6	100	25.51
30.5-40.5	1	5.6	33	8.42
20.5-30.5	4	22.2	115	29.34
15.5-20.5	3	16.6	60	15.31
10.5-15.5	3	16.6	43	10.97
5.5-10.5	4	22.2	36	9.18
Less than 5.5	1	5.6	5	1.28
Landless	1	5.6	0	0
Total	18	100	392	100.01
Gini Coefficient = 0.420				

Table 3.7 : Distribution of Land Holding in Meallyab

Area	No. of Households	per cent of Total	Total Area	per cent of Total
30.5-40.5	1	7.7	40	30.08
20.5-30.5	1	7.7	23	17.29
10.5-15.5	1	7.7	15	11.28
5.5-10.5	3	23.1	30	22.56
Less than 5.5	5	38.5	25	18.80
Landless	2	15.4	0	0
Total	13	100.01	133	100.01
Gini Coefficient = 0.489				

Table 3.8 : Distribution of Land holding in Wad-el-Kashif

Area	No. of Households	per cent of Total	Total Area	per cent of Total
More than 50.5	1	2.5	70	24.39
30.5-40.5	1	2.5	36	12.54
20.5-30.5	1	2.5	30	10.45
15.5-20.5	1	2.5	20	6.97
5.5-10.5	11	27.5	106	36.93
Less than 5.5	5	12.5	25	8.71
Landless	20	50.0	0	0
Total	40	100	287	99.99
Gini Coefficient = 0.709				

3.3 Labour

Most of the households in the area had a form of employment undertaken beside agricultural cultivation. Most of the jobs are in the services, trade and building (bricklaying, houserepair and building) sectors inside or outside the villages. Hiring out by the

household during the various agricultural seasons exists but only to a limited extent. This is so because most families, as was made clear to us, would prefer to work on their own plot or to hire in land rather than work out in other people's farms. The majority of labourers are either from the villages which had no rains during the year, or from groups of people who seek employment in the villages and who are from outside the region. We will concentrate on the labour transactions that took place during the various agricultural seasons and look at the forms of contracts and payment involved in the transaction.

Two types of labour contract prevail in the villages. The first is a day-to-day wage contract and dominates in the agricultural operations of ploughing, sowing and weeding. The second is in the form of an arrangement between the workers and farmers and is dominant in harvesting. In the first payment is by cash wage and when the work is done in the mornings a meal is often provided. In the arrangement for harvesting a price is usually agreed upon by the two parties in the cutting operation. The price is sometimes paid at the rate of a certain number of pounds per jada'a. Meals for the group of cutters is usually offered throughout the period of work. Ocassionally food materials are bought for workers instead of provision of ready cooked meals. Threshing, on the other hand is paid for the amounts of Ardabs threshed. Prices vary in the range of 2 to 3.5 pounds per Ardab. Often an additional payment in kind of part of the final output takes place and it amounts to one keila in every Ardab (which is equal to 20 keilas). This is paid in compensation for the irritation which threshed particles of dura cause the skin. Meals might also be provided.

Table 3.9 gives the total mandays hired in by the farmers

in the villages and the average cost per manday which is computed as the ratio of monetary outlay to the number of days purchased. In the calculation of total cost of hired labour we have not included the total value of kind payments. This would have made the average cost higher during the months of November-December where a meal is usually provided during the harvesting period.

Table 3.9 : Total Mandays hired in and Average cost in the sample

Month	Number of Mandays hired in	Average cost in Pounds per day
June-July	301	2.65
August-October	1297	2.90
November-December	2100	3.19

Note: In the calculation of mandays the weights of 1, 1, ½ were assigned to men, women and child labour

Table 3.9 indicates that demand for labour (mandays bought in) varies with the different agricultural seasons. It is highest during the peak season of harvesting. It is lowest through the months of June to July. This is the time when the main operation is that of ploughing and sowing. At this time mostly mechanical rather than human power is used. During the months of August to October as explained earlier, the main task is that of weeding. The average cost of one manday's worth of labour therefore varies with the season and is higher when demand for labour is high.

As explained in the theoretical exposition in the preceding chapter, one feature of the efficiency wage hypothesis which postulates

a connection between consumption and productivity of workers is the prevalence of an efficiency wage W^* which employers will choose to pay, independent of the conditions of labour supply to all workers under different production conditions, for all seasons and across regions. The variability of wages with the level of demand and supply in the different seasons for the villages would suggest that the efficiency wage model is inappropriate for the villages. We should note, however, that we are testing a strict version of the theory. This is so because one would suppose that the amount of nourishment required varies for different operations in different agricultural seasons. However another feature which is suggested by the model is that long term contract should dominate if employers were to gain from the benefits in terms of productivity from paying higher wages. All labour contracts in the villages are short-term day-to-day contracts. Long periods of contract (more than a day) occur during harvesting time. But there was no case of permanent employment for the whole year.

3.4 The Market for Tractor Hire

Beside human muscle power, the other source of motive power in the villages is tractor power. Ploughing and sowing and to a lesser degree threshing operations are carried out with the tractor for some of the farms. Of a total of 149 households who cultivated some land in the villages, 76 or more than 50 per cent used the tractor for ploughing and sowing. Table 3.10 gives the number of households who used the tractor in ploughing and sowing by size of their cultivated land. The Table shows that almost all farms of size 20 feddans and over have used the tractor in the operation of ploughing and sowing.

Table 3.10 : Number of households in Sample who hired Tractor in ploughing and sowing

Area	Total number of Households	Households who used Tractor	per cent of Total
≤ 5.5	28	9	32.14
5.5-10.5	56	24	42.85
10.5-15.5	22	9	40.91
15.5-20.5	20	13	65.0
20.5-30.5	10	10	100.0
30.5-40.5	7	5	71.43
40.5-50.5	5	5	100.0
+50.5	1	1	100.0
Total	149	76	51.01

The villagers hired the tractors from the few tractor owners who lived in the area. There were three tractor owners who cultivated the land of the villages. The three of them are rich persons who could afford the high price of a tractor or who had access to the credit facilities which are provided by some lending institutions which provide a loan for the purchase of tractors. For instance one of the tractor owners owns a farm in the mechanized area of Qadarif. Operators in that area were required to purchase a tractor unit, the money for which is made available through the Mechanized Farming Corporation which administers the schemes (see Chapter 1).

The tractor driver, accompanied by an assistant, is usually hired by the tractor owner. The prices of tractor hire would seem to be determined in a monopolistic way, with each tractor owner being confined to one or more of the villages. The market price (modal) for tractor hire is the samein Tamari, Tebeib, Wad-el-Kashif and Meallyab, amounting to three pounds per feddan. In Umshaniq the

modal price is four pounds per feddan.

The total cost of machine hire for ploughing and sowing could represent a considerable percentage of the total value of output particularly for small cultivators. This can be illustrated by an example. Assume that the average output of dura per feddan is 11 keilas (which is the mean output for owners-cultivators in the sample) and that the price of a keila is 1.5 pounds (the market price in Tamari and Umshariq) and that the cost of tractor hire is 3 pounds per feddan. In this case, the tractor cost comes to 18% of the total value of produced output. This percentage would be higher had the production been lower. If output is only 10 keilas per feddan (the mean output for landless tenants) the cost of tractor hire would amount to 20% of the value of output.

3.5 Credit

A widely known system of credit in most of the rural areas in the Sudan, in traditional as well as irrigated agriculture, is known as shail. In this system credit is usually advanced against standing or future crop, and is repaid in kind, the amount of output to be given as repayment being determined at the time of advancing the loan. When other forms of credit do not exist, shail provides an easily and accessible form of credit. A disadvantage of the system, however, is the high cost associated with it since the crop "mortgaged" in shail is usually valued at prices lower than the ones expected in the future.

The evidence of the presence of shail in the village is

insignificant. Only two farmers in our sample practised shail as borrowers. The first of them lives in Umshaniq and owns 16 feddans. The second lives in Tamari and owns 18.75 feddans. Both of them hired an additional amount of 7.5 feddans in addition to what he owns. The amounts exchanged in shail and the prices are summarized in Table 3.11.

Table 3.11 : Evidence of shail in the villages

	Amounts sold in shail (in Ardabs)	Shail price (pounds/Ardab)	Market Price (in pounds)	Shail price as per cent of Market price
Farmer from Umshaniq	1	12	30	40%
Farmer from Tamari	11	18	30	60%

It is obvious that the cost of credit is higher for the small farmer from Umshaniq than for the large land owner from Tamari. One reason may be that the large land owner can easily secure the credit at moderate terms than the small plot owner. In Gezira scheme it has also been observed that shail prices for all crops grown are higher for large land owners than for small ones. But unlike rainfed cultivation areas shail is widespread in Gezira. This can be explained by the fact that shail is used for many purposes in Gezira. For example shail is used there to provide the money for the hire of labour for the cotton picking and other production and consumption purposes.

One other reason for the rarity of shail in the villages is that credit is provided against the standing crop. Thus for a major operation like ploughing and sowing which might require the hire of a tractor the farmer cannot use shail. The crop is not there to see. In this instance the farmer had to turn to relatives and sons working in urban areas.

3.6 Concluding Remarks

In this chapter we dealt with the markets for factors in the villages. A description of the working and some features of the markets was provided. The analysis revealed that there is a large extent of landless families in the villages. More than a quarter of the families in our sample were landless and they hire in land for cultivation at a fixed cash rent. The degree of land concentration is summarized by a Gini coefficient of approximately 0.6.

As regards the labour market we have seen that wages tend to vary across the different agricultural seasons according to the strength of demand and supply of labour, being higher when demand for labour is at its peak.

We have also seen that the market for tractor hire is largely monopolistic with the few tractor owners setting the price. Borrowing through shail turned out to be insignificant and when it occurs it involves a high cost.

Some of the markets described in this chapter will be examined in more detail in the following chapters. The market for

land will be discussed in Chapter 6. Chapter 7 will provide more analysis of the labour markets, examining the movement of labour to urban areas and its determining factors. Some of the features of markets and the inter-relation between them will be used to explain what we find in our studies. The implication of the inter-relation between the market for credit and capital services for the allocation of resources will be discussed in Chapter 5. Some futher implications of the inter-relation between these two markets and the decision to allocate labour between rural and urban areas will be exposed in Chapter 7. The relationship between the market for labour and land will be examined in Chapter 6.

CHAPTER 4 : Consumption

4.1 Introduction

In this chapter we will study the spending patterns of households in rural areas; the commodity composition of the pattern and the demand for these commodities as influenced by the income of households. The Commodity composition of demand undoubtedly has an implication on the production and affects the pattern of demand for factors and therefore factors incomes.

Our tool of analysis will be the Engel curve which expresses the consumption on a particular commodity as a function of total income of the family. In its general form it is written as

$$Z_{ih} = f_i(y_h)$$

where Z_{ih} is consumption expenditure on commodity i by household h and y_h is the total income or consumption expenditure by the household. Using regression analysis this relationship will be exploited to look at how the expenditure on (or consumption) of a particular commodity varies with the income level of the household. The relationship will be utilized for a number of aims:

(1) To deduce parameters which indicate how the household allocate the various items in its budget (marginal shares), and the percentage change in demand for goods in response to a percentage change in income (income elasticities).

The income elasticities derived are, needless to say, important in the planning process for forecasting future demand for the commodities. We will also pose the question of the implications of these elasticities from the point of view of nutritional standards. We will also postulate a model (the extended linear expenditure system) which when estimated yields a measure of the bundle of subsistence consumption in rural Central Sudan. For given levels of income and prices the subsistence consumption bundle determines the minimum level of consumption expenditures which an average consumer in the rural area regards as necessary. This basic level could obviously be used to define poverty. The poor section of the population would then include all households with an annual income below the basic level of consumption expenditure for the average consumer. The model will also be used to look at the responsiveness of consumer demand for food to change in the price of food and the effect of this change in demand for other commodities.

(2) To explore the influence of the family composition in consumption of different commodities. We will do this by deriving household equivalence scales which are useful for welfare comparisons of households with different compositions. They can be used to convert the budgets of different household types to needs-corrected basis. Equivalencescales too play a central role in defining poverty line since minimal consumption standards vary with household composition.

(3) Finally the distribution of total expenditures and income, which no doubt affect the consumption patterns and demand, and the repercussions of the direct tax system in agriculture on this distribution will also be analysed.

The setting of this chapter runs as follows. Section 4.2 discusses the data and the variables. In Section 4.3 methodological issues, empirical as well as theoretical, are described. In Section 4.4 the empirical findings are studied and we deal there with the issues set in (1) above. In 4.5 the analysis relevant to (2) is undertaken and 4.6 addresses itself to the final purpose of income distribution and taxation. Section 4.7 rounds up the discussion with some concluding remarks and a summary of findings.

4.2 The Data

The data which will be used in this chapter are from the sample from the Households Budget Survey 1979/80. As we have explained in Chapter 2 the sample of 200 families was chosen by stratified random sampling from the rural areas of three provinces which constitute the Central Region of Sudan: Gezira, Blue Nile and White Nile. Of the 200 families 103 (51.5%) were occupied in farming activities. The rest were distributed among the category of skilled and non-skilled workers (in services, sales and production) 60 (30%), Technocrats (clerical, administrative, managerial, professional and technical workers) 20 (10%), and others not classifiable by occupation 17 (8.5%).

4.2.1. The Dependent Variables: The Commodities in the household budgets were gathered to give the following broad commodity groups:

TABLE 4.1 : Classification of Commodity Groups

Commodity Title	Components
Food and Drinks	Food, beverages and tobacco
Cloth and Footwear	
Housing	Rent, water, fuel and light
Durables	Furniture, furnishings, household equipment (kitchen hardware, china, glass)
Health and Medicine	Health expenses
Transport	
Education and Recreation other "Non Food"	Mainly soap, matches, perfumes, tooth pastes, leather made products

The food and drinks category was disaggregated to give thirteen items as shown in Table 4.4. The cereal and cereal products include amongs its components the value of purchased wheat bread for which a separate demand function was estimated. For the majority of the population in rural areas, however, dura still remains the main staple food crop.

The total value of expenditure on the commodity groups or in any given commodity in the food item is going to be the dependent variable in the estimated demand functions.

4.2.2. The Independent Variable

Total consumption expenditure can be chosen as the determining variable of expenditure in any one commodity. This can be

justified on the grounds that "while total expenditure may depend in a complicated way on income expectations and the like, the distribution of expenditures among the various commodities depends only on the level of total expenditure" (Prais and Houthakker, 1971, p.81).

Another argument in favour of using total expenditure in place of income is that often in budget surveys, the reported income may be under-estimated and is subject to errors of omission and under reporting by the household. Furthermore the one period static demand theory defines income as equivalent to total expenditure.

The choice of total expenditure as an explanatory variable will, however, result in biased estimates of the parameters of Engel curves as a result of simultaneous relationship of expenditure on each item and total expenditure (Summers, 1959). One way which is suggested to avoid the bias in the estimated parameters is to use the method of instrumental variables for estimating the parameters of Engel curves. Liviatan (1961) suggested using measured income as the instrument. Lluch et al (1977) used an extended linear expenditure system and showed that their method and Liviaton are identical. We followed the method suggested by Lluch et.al in our estimations which are reported in this chapter.

Table 4.2 gives the mean values of annual consumption expenditures, income and the mean of household size and age of head for the three provinces and for the whole sample. The highest mean income is for White Nile Province followed by Gezira and then the Blue Nile. The average family size for the whole region is 6.61 members while the mean age of head is 42.03 years. From Table 4.3 we can see that the largest budget share in the households' budgets goes to food followed by expenditure on the other "Non Food" category, which included the manufactured items in the budget, and on cloth and footwear

and on housing. Next comes the expenditure on education and recreation and on transport. Table 4.4 gives the percentage distribution of expenditure on food items by expenditure classes. The largest percentage in the food and drink category for all income classes goes to cereals and cereal products. The percentage of this item, however, shows a declining trend as expenditure rises. The second biggest percentage goes to meat. Sugar comes in third place followed by expenditure on vegetables and then oils and fats for low income classes and on milk and dairy products for middle and high income groups. Expenditures on milk and dairy products show an increasing percentage share as income rises while the percentage share of oils and fats decline as income rises. The percentage share on sugar, tea and coffee declines with increases in expenditure.

4.3 Methodology

4.3.1 Empirical Specifications

Following Lluch et al (1977) one functional form for the determination of consumption expenditure on commodity q_i defined as $p_i q_i = Z_i$ by household h can be written

$$Z_{ih} = P_{ih}\gamma_i + B_i^* (y_h - \Sigma_1 P_{ih}\gamma_j) + e_{ih} \quad i = 1 \ldots N \text{ and } h = 1,\ldots H \quad (1)$$

where y is a given amount of spendable disposable income, P_i is the price of commodity q_i paid by household h and (γ_i, B_i^*) are parameters to be estimated. The system in (1) is referred to as an extended Linear expenditure system (ELES). Summing all the expenditure equations in (1) over i we obtain

$$Z_h = (1-u)\,\Sigma P_{ih}\gamma_i + uy_h + E_h \qquad (2)$$

where $E_h = \Sigma_i e_{ih}$ and $u = \Sigma_i B_i^*$. The error terms e_{ih} and E_h are assumed to satisfy the classical assumptions of a zero mean and constant variance. From (2) we solve for y_h in terms of Z_h which on substituting in (1) yields a linear expenditure system (LES)

$$Z_{ih} = P_{ih}\gamma_i + B_i(Z_h - \Sigma_j P_{ih}\gamma_i) + u_{ih} \qquad (3)$$

where $Z_h = \Sigma_i Z_{ih}$ is total expenditure, $B_i = B_i^*/u$, and $u_{ih} = e_{ih} - B_i E_h$. In the LES Bi's are the marginal budget shares $\delta Z_{ih}/\delta Z_h$. That is, marginal propensities to consume out of total expenditure, so that $\Sigma_i B_i = 1$. In ELES in (1) the B_i^* are marginal propensities to consume out of income, so that $\Sigma_i B_i^* = u$, the aggregate marginal propensity to consume. The γ_i which appears in both systems may be interpreted as the minimum basic subsistence expenditure if they are positive and $\Sigma_i P_j \gamma_j$ as the total subsistence expenditure. In LES, $Z_h - \Sigma_j P_{jh}\gamma_j$ are interpreted as "supernumerary" expenditure, which is to be allocated among commodities in the proportions B_i. In ELES $y_h - \Sigma_j P_{jh}\gamma_j$ represents supernumerary income.

Assuming that all households face identical prices $P_{ih} = P_i$, the $P_i\gamma_i$ terms become independent of the unit of observation and may be replaced by γ_i^* where γ_i^* measures subsistence expenditure in prices prevailing at the time of the household survey. Thus in comparing γ^* across different groups of consumers the estimates will reflect any differences in prices paid by various groups. The system in (1) may now be written as

$$Z_{ih} = \alpha_i + B_i^* y_h + e_{ih} \qquad (4)$$

$$Z_h = (1-u)\,\Sigma P_{ih}\gamma_i + uy_h + E_h \qquad (2)$$

where $E_h = \Sigma_i e_{ih}$ and $u = \Sigma_i B_i^*$. The error terms e_{ih} and E_h are assumed to satisfy the classical assumptions of a zero mean and constant variance. From (2) we solve for y_h in terms of Z_h which on substituting in (1) yields a linear expenditure system (LES)

$$Z_{ih} = P_{ih}\gamma_i + B_i(Z_h - \Sigma_j P_{ih}\gamma_i) + u_{ih} \qquad (3)$$

where $Z_h = \Sigma_i Z_{ih}$ is total expenditure, $B_i = B_i^*/u$, and $u_{ih} = e_{ih} - B_i E_h$. In the LES Bi's are the marginal budget shares $\delta Z_{ih}/\delta Z_h$. That is, marginal propensities to consume out of total expenditure, so that $\Sigma_i B_i = 1$. In ELES in (1) the B_i^* are marginal propensities to consume out of income, so that $\Sigma_i B_i^* = u$, the aggregate marginal propensity to consume. The γ_i which appears in both systems may be interpreted as the minimum basic subsistence expenditure if they are positive and $\Sigma_i P_j \gamma_j$ as the total subsistence expenditure. In LES, $Z_h - \Sigma_j P_{jh}\gamma_j$ are interpreted as "supernumerary" expenditure, which is to be allocated among commodities in the proportions B_i. In ELES $y_h - \Sigma_j P_{jh}\gamma_j$ represents supernumerary income.

Assuming that all households face identical prices $P_{ih} = P_i$, the $P_i\gamma_i$ terms become independent of the unit of observation and may be replaced by γ_i^* where γ_i^* measures subsistence expenditure in prices prevailing at the time of the household survey. Thus in comparing γ^* across different groups of consumers the estimates will reflect any differences in prices paid by various groups. The system in (1) may now be written as

$$Z_{ih} = \alpha_i + B_i^* y_h + e_{ih} \qquad (4)$$

TABLE 4.2 : Mean Value of Annual Consumption Expenditures (in pounds), Income and Mean of Household Size and Age of Head

AREA	SAMPLE SIZE	SIZE OF FAMILY	AGE OF HEAD	INCOME	EXPENDITURE	FOOD AND DRINKS	CLOTH AND FOOTWEAR	HOUSING	DURABLES	HEALTH & MEDICINE	TRANSPORT	EDUCATION & RECREATION	OTHER "NON FOOD"
Gezira	117	6.55 (.296)	42.19 (1.32)	1123.09 (145.769)	801.025 (49.491)	555.86 (26.154)	52.870 (5.187)	47.055 (2.192)	15.927 (2.740)	7.113 (1.502)	38.046 (13.107)	24.901 (13.999)	59.44 (8.512)
White Nile	45	7.267 (.429)	40.422 (1.764)	1142.133 (233.032)	686.954 (99.152)	532.617 (89.93)	44.739 (4.866)	53.551 (6.401)	9.105 (1.741)	4.543 (1.140)	7.701 (1.891)	15.117 (2.022)	34.580 (4.971)
Blue Nile	38	6.00 (.66)	43.447 (2.315)	1020.95 (384.959)	443.864 (48.526)	336.407 (29.764)	33.768 (5.960)	20.941 (3.762)	3.433 (1.832(	7.970 (5.522)	7.086 (2.357)	12.635 (4.565	21.623 (3.095)
All	200	6.61 (.236)	42.03 (.983)	1107.972 (123.255)	707.498 (38.731)	508.938 (26.503)	47.411 (3.448)	40.18 (2.161)	11.903 (1.717)	6.689 (1.385)	25.336 (7.753)	20.369 (2.558)	46.663 (5.246)

Note: Figures in Parenthesis are the standard errors.

TABLE 4.3 : Average Budget Shares at Sample Mean Values

Commodity / Area	Food & Drinks	Cloth & Footwear	Housing	Durables	Health & Medicine	Transport	Education & Recreation	Other "Non Food"
Gezira	.693	.066	.058	.019	.009	.047	.031	.074
White Nile	.775	.065	.056	.013	.006	.011	.022	.050
Blue Nile	.758	.076	.047	.007	.018	.016	.028	.048
All	.719	.067	.056	.016	.009	.035	.028	.066

TABLE 4.4 : Percentage Distribution of Expenditure on Food

Commodity \ Expenditure level	600	600-1200	1200
Cereal and Cereal Products	19.93	15.77	16.04
Root Crops and Pulses	1.31	1.40	1.18
Milk and Dairy Products	5.08	5.88	6.58
Oils and Fats	5.77	5.19	3.97
Meat	15.74	15.31	16.05
Fish	0.35	.05	.55
Vegetables	7.92	7.55	5.11
Fruits	.72	1.13	.97
Sugar	11.64	11.16	7.71
Tea and Coffee	4.72	4.16	2.13
Other Food Stuff	2.89	2.30	1.67
Drinks	0.55	.29	.53
Tobacco	.90	1.65	2.09
Wheat Bread	1.13	1.58	1.97

where $\alpha_i = \gamma_i^* - B_i^* \Sigma_j \gamma_j^*$. The error term e_h is to satisfy the classical assumptions of ordinary least squares, i.e. zero mean, constant variance and absence of correlation of the errors across consumers.

The associated ELES aggregate consumption function is

$$Z_h = \alpha + u\, y_h + E_h \qquad (5)$$

where $\alpha = \Sigma_i \alpha_i = (1-u)\Sigma\gamma_i^*$. Elimination of y_h from (4) and (5) yields LES

$$Z_{ih} = \alpha_i' + B_i Z_h + u_{ih} \qquad (6)$$

where $\alpha_i' = \alpha_i - B_i \alpha = \gamma_i^* - B_i^* \Sigma \gamma_j^*$. The system is one of identical regressors in which every left-hand variable is regressed on the same set of exogenous variables. It follows that estimation of each of its equations by ordinary least squares, commodity by commodity, is equivalent to systems maximum likelihood estimation.

Maximum likelihood estimates of B_i and u are obtained from estimates of B_i^* using the relationships

$$u = \Sigma_i B_i^* \,, \quad B_i = B_i^*/u = B_i^*/\Sigma_i B_i^* \qquad (7)$$

Maximum likelihood estimates of γ^* and $\Sigma\gamma_i^*$ can be obtained using the

following relationship

$$\Sigma_i \gamma_i^* = (1 - \Sigma_i B_i^*)^{-1} \Sigma \alpha_i = (1-u)^{-1} \Sigma_i \alpha_i$$

$$\gamma_i^* = \alpha_i + B_i^* \Sigma_j \gamma_j^* \qquad (8)$$

The parameters of the ELES will be estimated only for groups of commodities and not for separate items. Because of the limitations of linear forms of the type $\alpha_i + B_i Z_h$ other functional forms will be fitted. The implications of linearity in terms of the evolution of income elasticities with respect to income are said to be unsatisfactory from an economic point of view. For instance for luxury goods ($\alpha_i < 0$) i.e. goods which take up a larger share of the budget of better-off households, the curves have an income elasticity that declines with an increasing income while the reverse is true for necessities ($\alpha_i > 0$) i.e. goods which take a smaller share of the budget as income rises. Intuitively one would expect the opposite to happen. For this reason and others which will become clear below the following functional forms will also be fitted:

$$W_i = \alpha_i + B_i \ln Z_h \qquad (9)$$

$$Z_{ih} = \alpha_i + B_i \ln Z_h \qquad (10)$$

$$\ln Z_{ih} = \alpha_i + B_i \ln Z_h \qquad (11)$$

$$\ln Z_{ih} = \alpha_i - B_i / Z_h \qquad (12)$$

where $W_i = Z_{ih}/Z_h$ is the budget share in good q_i. The marginal budget shares $\partial Z_{ih} / \partial Z_h$ and the income-elasticities for each one of

the functional forms are shown in Table 4.5. No price effects are included because of cross-section analysis in which constancy of prices is assumed but can be deduced in case of LES.

TABLE 4.5 : Marginal Budget share, income and price elasticities formulas

Function	Equation	$\frac{\partial Z_{ih}}{\partial Z_h}$	$e_{iz} = \frac{\partial Z_{ih}}{\partial Z_h}\frac{Z_h}{Z_{ih}}$	$e_{ij} = \frac{\partial Z_{ih}}{\partial p_j}\frac{P_j}{Z_{ih}}$
LES	6	B_i	$B_i Z_h / Z_{ih}$	$\phi e_{iz} - e_{iz} W_i (1+\phi e_{iz})$, $i = j$ $-e_{iz} W_j (1+\phi e_{iz})$, $i \neq j$
Semi-log	10	B_i / Z_h	B_i / Z_{ih}	-
Double-log	11	$B_i Z_{ih} / Z_h$	B_i	-
Log-inverse	12	B_i / Z_h^2	B_i / Z_h	-

Notes: (1) e_{iz} is the elasticity of commodity i with respect to total expenditure Z_h.

(2) e_{ij} is the elasticity of i with respect to change in the price of commodity j.

(3) $-\phi = (Z_h - \Sigma_j \gamma_j)/Z_h$ and is the supernumerary ratio.

The model in (9) was proposed by Working (1943) and Leser (1963) and was extended by Deaton and Muellbauer to be used for time series analysis (Deaton and Muellbauer, 1980, pp.75-76). The latter referred to it as the Almost Ideal Demand System (AIDS). The model relates the budget shares W_i to the logarithm of outlay. The model allows luxuries ($B_i > 0$), necessities ($B_i < 0$) and

inferior goods.

We observe that the expenditure elasticities in the semi-log (10) declines steadily with increasing expenditure on the good and that when $Z_{ih} = 0$, $Z_h = \exp(-\alpha_i/B_i)$ which is always positive so that income must reach some positive value before any expenditure takes place. This might seem applicable to some goods but for necessities it is possible that even with zero income expenditure will not fall to zero because people can draw on their past assets and reserves. The semi log function also cannot cope with curvature convex to the income axes. For this purpose the system in (9) seems appropriate and provide Engel curves which are convex (concave) to the income axis according as $B_i \gtrless 0$ and a straight line when $B_i = 0$. The double-log form in (11) is also satisfactory for data which exhibit non-linearity. It has a constant elasticity at all income levels and provide convex (concave) curvature according as $B_i \lesssim 1$ and a straight line when $B_i = 1$. For income-elastic goods exhibiting an upward curvature the double-log is suitable but for necessities it might not give a good fit because the constant elasticity characteristics may restrict its curvature. The log-inverse in (12) indicates that expenditure elasticities decline with increasing income and has the additional property in that expenditure on any item tends to a finite limit as income tends to infinity. The function thus seems to be suited for fitting expenditure on necessities. Since our main aim is to look at the fitting possibilities of the curves in (10), (11) and (12) at theobserved ranges of income, the properties of the curves in (11) and (12) at the extreme values should not be given any undue consideration.

4.3.2 Utility Basis of Demand Functions

Samuelson (1947-48) and Geary (1950-51) have worked out the utility function from which the LES may be derived by constrained maximization. This, known as the Stone-Geary utility function takes the following form

$$u = \Sigma_i B_i \log (q_i - \gamma_i) \qquad (13)$$

$$0 < B_i < 1, \Sigma_i B_i = 1, \quad q_i - \gamma_i > 0$$

Maximization of (13) subject to the budget constraint $\Sigma p_i q_i = Z_h$ will result in the LES

$$Z_i = p_i q_i = P_i \gamma_i + B_i (Z_h - \Sigma_i \gamma_i P_i) \qquad (14)$$

of which the stochastic version in (3) in Section 4.3.1 is shown.

On the other hand a utility function which yields Linear Engel curves takes the following form (Phlips, 1974, pp.58-59)

$$u = \Sigma_i a_i q_i + \frac{1}{2} \Sigma_i \Sigma_j a_{ij} q_i q_j \qquad (15)$$

with all $a_{ij} = 0$ $(i \neq j)$ and $a_{ii} < 0$. The condition $a_{ii} < 0$ implies that the utility function in (15) is concave. Assuming that $n = 2$ and maximizing (15) subject to the constraint $\Sigma p_i q_i = Z_h$ with P_i set equal to unity yields the demand functions

$$q_1 = \alpha_1 + B_1 Z_h \quad , \quad q_2 = \alpha_2 + B_2 Z_h \qquad (16)$$

where

$$\alpha_1 = \frac{a_2 - a_1}{a_{11}+a_{22}} \quad , \quad \alpha_2 = \frac{a_1 - a_2}{a_{11}+a_{22}} ; \quad B_1 = \frac{a_{22}}{a_{11}+a_{22}} \quad , \quad B_1 = \frac{a_{11}}{a_{11}+a_{22}}$$

There are certain properties of demand equations which result from the fact that a demand system is obtained by utility maximization. These properties will take the form of mathematical restrictions on the derivatives of the demand functions (see Phlips, 1974, Chapter 2). When prices are assumed constant all restrictions in terms of price derivatives (homogeneity, symmetry, negativity of own substitution effect) disappear. The only restriction that remains is the adding up condition (Phlips, 1974, p.105); this says that if

$$Z_i = p_i q_i = f_i(y)$$

$$\Sigma_i f_i(y) = y$$

$$\text{or} \quad \Sigma_i \frac{dZ_i}{dy} = 1 \qquad (17)$$

$\frac{dZ_i}{dy}$ is the marginal propensity to consume good i or its marginal budget share. According to (17) the sum of the marginal propensities to consume (or the marginal budget shares) has to be equal one at all income levels. In other words an increase in total expenditure must be entirely allocated to the different commodities.

The linear forms in (14) and (16) satisfy the adding-up

restriction if $\Sigma\alpha_i = 0$ and $\Sigma\beta_i = 1$. If the model in (9) is estimated equation by equation by ordinary least squares, the estimated parameters α_i and β_i will satisfy the adding-up restriction automatically (see results for linear form and AIDS below).

4.4 Empirical Findings

4.4.1. Extended Linear Expenditure System (ELES)

We look first at the results for the ELES. The estimated coefficients for equations (4) and (5), which are obtained from regressing expenditure on each commodity group and total expenditure on income are shown in Table 4.6. The results in Table 4.7 show the associated calculations for ELES of equation (6).

The results in Table 4.6 are the marginal propensities to consume out of income for the eight commodity groups, and the aggregate marginal propensity to consumer, u. The correlation coefficients R^2 and the Durbin-Watson statistic d^* are also shown. The correlation coefficients for regression on total income is small compared with the correlation coefficients obtained from a regression on total expenditure. Failure of income to provide a better explanation of the total variation in household expenditure could be attributed to the fact that income received during the period of survey does not provide a measure of the household "normal" standard of life. In other words the measured income suffers from the 'error in variables' problems. This is particularly true of our sample which is dominated by farming households where the income accruing to the family may not be steady over the year and where the variance in the "transitory" component in income may be large. The ultimate effect of this is to result in an underestimated value of the marginal propensity to consume (Wallis, 1973, Chapter 1). The aggregate propensity to consume as it

appears in the last row in Table 4.6 is 0.136, which is obviously very low. Bearing the above considerations in mind the associated ELES results should be approached with caution. The γ^* are shown in the

TABLE 4.6 : Regression Results : Dependent Variable : Consumption Expenditure for the Commodity Groups Listed

Independent Variable : Disposable Income

Commodity	α_i	B_i^*	R^2	d^*
Food and Drinks	432.766	.068 (4.75)	.10	1.79
Cloth and Footwear	33.123	.013 (7.31)	.21	2.124
Housing	33.223	.006 (5.39)	.13	2.04
Durables	6.934	.004 (4.78)	.10	1.85
Health and Medicine	3.249	.003 (4.05)	.07	2.08
Transport	-.999	.023 (5.74)	.14	2.28
Education and Recreation	9.619	.009 (7.44)	.21	2.47
Other "Non Food"	35.025	.010 (3.58)	.06	2.02
Total Expenditure	527.164	.136 (7.85)	.24	2.25

Notes (1) Figures in Parenthesis are the t-statistics.

(2) d^* is Durbin-Watson statistics. d^* is obtained after ordering cases in an ascending order by size of the independent variable which is total disposable income in this case. In cross-section analysis the value of d^* thus obtained can be used to check for misspecification.

(3) Total number of observations used in regression is 200.

TABLE 4.7 : Extend Linear Expenditure System (ELES) Results

Commodity	γ_i^*	e_{iz}	e_{ii}	e_{il}
Food and Drinks	476.284	0.69	-.532	-
Cloth and Footwear	41.442	1.418	-.217	-.952
Housing	37.063	.785	-.115	-.509
Durables	9.494	1.812	-.196	-1.217
Health and Medicine	5.169	.222	-.023	-.149
Transport	13.720	4.828	-.55	-3.242
Education and Recreation	15.379	..214	-.026	-.143
Other "Non Food"	41.424	1.106	-.17	-.742

Notes : (1) γ_i^* are measured in pounds per annum

(2) e_{il} is the cross price elasticities with respect to food prices

first column of Table 4.7 and may be interpreted as the minimum annual subsistence expenditure on the commodities. They are positive. The limitations of the estimates however should be borne as they only reflect to an extent the behaviour of an average household in sample relative to the prevailing standards of living. The estimated minimum subsistence expenditure on food implies that the monthly minimum amounts to L.S. 39.69 Culwick (1951, p.147) on the basis of ordinary Gezira diet proposed an intermediate diet, diet A, and an improved diet, B, which were intended to be a flexible model to suit the seasonal variations in the food in the region and the changing conditions. She estimated that diet B would cost between L.S. 9.78 and 11.04 per month depending on the price of grain, for a family of 6 persons. The same diet was estimated by Taha (1977, p.100) to cost L.S. 24.72 per month in 1977 prices. The Department of Statistics constructed cost of living indices which showed that for the low-income brackets (L.S.300-500), the cost of living index for the food and drinks category has been growing between 1977 and 1978 at the rate of 26.28 per cent. Assuming that the rate of growth in the indices remains constant over the period 1978 to 1980, diet B would have cost L.S.39.42 in 1980 which can be compared with our minimum subsistence estimate of L.S.39.69. However, the assumption that the rate of change in price has remained constant over the period 1978 to 1980 at 26.28 per cent is unrealistic particularly when one considers the inflationary tendencies which followed the implementation of the job evaluation and classification scheme in 1978 and which sent the price of food rocketing. If one assumes that the rate of growth in the food cost of living index between 1978 and 1980 has been twice that between 1977 and 1978, Culwick diet B would have cost L.S.57.53 monthly and would be higher than the estimated minimum subsistence at the prevailing standards of living in 1980.

Culwick's improved diet was set on the basis of nutritional standards that takes the allowances stipulated by B.M.A. into consideration. It is less dependent upon the staple food, sorghum, and contains more of the animal products, oil and vegetables than the intermediate diet (Culwick, 1951, p.149). One may therefore assume that the mimimum subsistence expenditure on food falls short of the total expenditure that is supposed to provide an improvement in the nutritional standards of the population.

Income elasticities are shown in the second column of Table 4.7. These are lower than the elasticities estimated from a linear regression on total expenditure except for transport and cloth as a comparison with the results in Table 4.12 would indicate. This can be explained in terms of the low marginal propensities to consume on which the estimated values of B_i depend. Own price elasticities e_{ii} are all negative as required by the underlying utility function and are less than unity. Cross price elasticities are estimated with respect to food which takes the largest proportion in the budget. These reveal that the effect of a change in the price of food is much stronger on the demand for commodities that can be classified as luxuries than on necessities, the effect varying positively with the magnitude of the income elasticities.

4.4.2 Other Functional Forms

We turn now to the results for the functional forms in equating (9) to (12). In the regression to fit these equations the variables are expressed in per capita terms by deflating by household size. Our independent variable is the total expenditure per person

in the family while the dependent variable is the expenditure per person on a given commodity. Deflation by household size is a simple way of incorporating the effect of family size in consumption expenditure. Non inclusion of the effect of household size in the analysis would result in biased estimates of the parameters because household size and total expenditure are positively correlated.

The results for the Almost Ideal Demand System (AIDS), equation (9), are shown in Table 4.8. The α's add to unity and the B's to zero as we expected. Food and drinks, cloth and footwear are classified as necessities ($B_i < 0$) while the remaining commodities are classified as luxuries ($B_i > 0$). Hence Engel curves for food and drinks and cloth and footwear are concave form below whereas the rest of the commodities have Engel curves that are convex from below. Among the food and drink items, cereal and cereal products, oils and fats, sugar, tea and coffee and fish takes a smaller proportion of the budget as income increases.

Table 4.9 presents the results for the estimated coefficients of the Engel curves of equations 10, 11 and 12 together with results for a linear Engel curve.

(i) Goodness of Fit : we look at how the four models presented in Table 4.9 fare in terms of goodness of fit. For this values of R^2 will be used. R^2 measures the percentage of total variation in the dependent variable that is explained by the independent variable. We will also look at the values of Durbin-Watson statistics d^* which are obtained after arranging the cases by the magnitude of the determining variable i.e. total expenditure per capita. In time series analysis

TABLE 4.8 : Estimated Coefficients of the Almost Ideal Demand System (AIDS)

Form / Commodity	α	B	R^2	d*
Cereal & Cereal Products	.669	-.103 (9.876)	0.33	1.35
Root Crops & Pulses	.001	.003 (1.771)	0.02	2.19
Milk & Dairy Products	-.016	.015 (2.65)	.03	2.15
Oils & Fats	.094	-.009 (3.328)	.06	2.10
Meat	.045	.023 (3.206)	.05	1.74
Fish	.013	-.002 (1.879)	.02	2.04
Fruits	-.007	.003 (3.775)	.07	1.72
Vegetables	.061	.003 (.854)	.003	1.85
Sugar	.154	-.009 (1.995)	.02	1.77
Tea & Coffee	.090	-.009 (4.709)	.10	2.03
Other Food Stuff	.041	-.063 (1.792)	.02	1.96
Drinks	-.005	.002 (.942	.004	1.99
Tobacco	-.018	.007 (2.478)	.03	1.87
Wheat Bread	-.020	.007 (4.053)	.07	1.84
Food & Drinks	1.118	-.079 (7.391)	.22	2.12
Cloth & Footwear	.075	-.001 (.283)	.0004	1.77
Housing	.012	.010 (2.716)	.04	2.13

Table 4.8 cont'd.....

Commodity \ Form	α	B	R^2	d*
Durables	-.029	.009 (3.948)	.07	2.13
Health & Medicine	-.012	.004 (3.356)	.03	2.16
Transport	-.060	.017 (3.70)	.06	2.14
Education & Recreation	-.016	.008 (3.047)	.04	2.20
Other "Non Food"	-.088	.032 (4.814)	.10	2.29

Notes: (1) The dependent variable in the demand function is the budget share for the commodities listed. The independent variable is the logarithm of per capita total expenditure.

(2) Figures in Parentheses are the t-statistics

(3) Total number of observations used in regression is 200.

(4) In summing the α's and B's the coefficients for wheat bread should be excluded as they are implied in the estimated coefficients for cereal and cereal products.

d^* measures the degree of serial correlation between residuals. In cross-section analysis when values of d^* are obtained after arranging cases in ascending order by magnitude of determining variable they can be used to check whether the form used is misspecified or not (Wallis, 1973, pp.41-43).

Values of R^2 are shown in Table 4.10. It can be seen that the values are high and that the differences between the coeffic ients are small. For most of the food items the linear form seems to produce a high R^2 compared with the semi-log. Among all forms the linear gives the best fit for drinks, tobacco and wheat bread. Excluding the latter commodities, however, the log-inverse and double-log form gives a high R^2 compared to the semi-log. Between the log-inverse and double-log the latter shows generally a better fit compared to the former. When we look at values for d^* in Table 4.11 we find that for three commodities (Root crops and pulses, sugar, tea and coffee) the error terms of the fitted linear form are serially correlated. The double-log form is unsatisfactory on this test for meat and sugar while the log-inverse is unsatisfactory for cereals, meat and wheat bread. The semi-log form is the most satisfactory on this test among all groups. For commodity groups the double-log seems to be generally superior to other forms both on the test of R^2 and Durbin-Watson statistics d^*. On both R^2 and d^* one may therefore prefer the double-log estimates.

(iii) Marginal Budget Shares

As the result of the linear form in the first column of Table 4.9 shows, increases in income result in a positive increase in

all commodities in the household budget. The table reveals that of a given marginal increase in income about 58 per cent will go to food and drinks. The other "non food" category which is composed mainly of manufactured items will command the second largest percentage share in the marginal allocation of family budgets with marginal share amounting to about 15%. This is followed by a marginal budget share of about 8% on cloth and footwear, 6% on housing and another 6% on transport. The marginal budget share for the household durables is 3.6% and for education and recreation it is 2.6%.

Within the food and drinks category the largest marginal budget share of about 9% goes to cereals and their products. This is followed by 16% on meat, 7% on sugar, 6% on vegetables, 6% on milk and dairy products and 3.5% on oils and fats. For the rest of the commodities within the food and drinks group each takes more or less an equal marginal share of about 2%.

(iii) Income Elasticities

Income elasticities estimated from regressions using variables measured in per capita terms are shown in Table 4.12. As the estimates indicate expansion of income results in asymmetrical expansion of demand. While demand for some commodities will rise very rapidly, demand for others will rise slowly or even decline. In general the foods which provide the bulk of calories and carbohydrates, such as starchy staples, have alower income elasticity than those which provide proteins.

There are differences between the estimates of the elasticities

TABLE 4.9 : Regression Coefficients derived from fitting Four Engel Curves

Commodity \ Form	Linear	Double-log	Semi-log	Log-Inverse
Cereals & Cereal Products	.088 (10.198)	.474 (9.504)	12.227 (8.914)	-36.386 (7.232)
Root Crops & Pulses	.018 (7.991)	1.117 (11.057)	2.447 (6.826)	-101.277 (10.461)
Milk & Dairy Products	.058 (11.674)	1.444 (10.329)	8.855 (11.089)	-138.971 (10.739)
Oils & Fats	.035 (13.430)	.759 (16.069)	5.336 (13.644)	-70.031 (15.469)
Meat	.160 (21.128)	1.232 (19.697)	23.471 (19.211)	-116.155 (19.959)
Fish	.003 (2.405)	.258 (2.335)	.253 (1.527)	-24.525 (2.361)
Vegetables	.057 (16.430)	1.047 (18.316)	8.922 (18.107)	-102.653 (20.779)
Fruits	.013 (12.516)	1.395 (12.090)	1.766 (10.082)	-132.165 (12.287)
Sugar	.068 (16.634)	.998 (15.596)	10.910 (17.828)	-102.637 (19.672)
Tea & Coffee	.022 (9.716)	.702 (13.439)	3.695 (11.659)	-67.003 (13.878)
Other Food Stuff	.018 (10.78)	.806 (15.468)	2.746 (10.657)	-71.919 (14.673)
Drinks	.015 (5.040)	.218 (1.432)	1.799 (3.944)	-11.130 (.777)
Tobacco	.022 (5.599)	.728 (5.548)	3.119 (5.288)	-63.118 (5.063)
Wheat Bread	.022 (11.416)	1.226 (9.084)	3.108 (31.615)	-94.498 (6.995)
Food & Drinks	.577 (32.058)	.871 (48.422)	85.668 (28.473)	-77.109 (29.915)
Cloth & Footwear	.076 (11.538)	.993 (9.325)	10.056 (9.362)	-84.378 (8.122)
Housing	.060 (15.301)	1.240 (16.776)	8.996 (14.810)	-115.567 (16.465)
Durables	.036 (9.633)	.923 (8.227)	4.334 (7.039)	-73.760 (6.696)
Health & Medicine	.011 (4.567)	.816 (7.233)	1.587 (4.282)	-78.655 (7.482)
Transport	.061 (8.043)	1.067 (8.394)	7.244 (5.937)	-93.386 (7.643)
Education & Recreation	.026 (8.818)	1.182 (9.713)	3.950 (8.656)	-110.981 (9.709)
Other "Non Foods"	.153 (9.37)	1.289 (24.324)	18.719 (7.026)	-111.114 (18.402)

Notes : (1) The dependent variable in the regression is the per capita expenditure on the commodities listed. The independent variable is total expenditure per capita.

(2) Figures in Parentheses are the t-statistics

(3) Total number of observations used in regression is 200.

TABLE 4.10 : Correlation Coefficients for four Engel Curves

Commodity \ Form	Linear	Double-log	Semi-log	Log-Inverse
Cereal & Cereal Products	.34	.31	.29	.21
Root Crops and Pulses	.24	.38	.19	.36
Milk & Dairy Products	.38	.35	.38	.37
Oils & Fats	.48	.57	.48	.55
Meat	.69	.66	.65	.67
Fish	.03	.03	.01	.03
Vegetables	.58	.63	.62	.69
Fruits	.44	.43	.34	.43
Sugar	.55	.55	.62	.66
Tea & Coffee	.32	.48	.41	.49
Other Food Stuff	.37	.58	.36	.52
Drinks	.11	.07	.07	.003
Tobacco	.14	.13	.12	.11
Wheat Bread	.40	.29	.33	.20
Food & Drinks	.84	.92	.80	.82
Cloth & Footwear	.40	.31	.31	.25
Housing	.54	.59	.53	.58
Durables	.32	.25	.20	.18
Health & Medicine	.10	.21	.08	.22
Transport	.24	.26	.15	.23
Education & Recreation	.28	.32	.27	.32
Other "Non Food"	.31	.75	.20	.63

Note: The correlation coefficients pertain to the regressions presented in Table 9.

TABLE 4.11 : Durbin-Watson statistics d^{*} [(1)] for four Engel Curves

Commodity \ Form	Linear	Double-log	Semi-log	Log-Inverse
Cereal & Cereal Products	2.12	1.88	1.95	1.64*
Root Crops & Pulses	2.51*	2.07	2.35	2.00
Milk & Dairy Products	2.15	2.13	2.17	2.19
Oils & Fats	2.25	1.96	2.29	1.88
Meat	2.19	1.61*	1.89	1.66*
Fish	2.13	2.10	2.09	2.10
Vegetables	1.70	1.74	1.97	2.10
Fruits	2.09	2.04	1.80	2.06
Sugar	1.66**	1.54*	1.99	1.99
Tea & Coffee	1.56*	1.81	1.79	1.90
Other Food Stuff	1.96	1.89	1.98	1.70
Drinks	2.27	1.85	2.16	1.83
Tobacco	2.09	2.06	2.05	2.00
Wheat Bread	1.91	1.83	1.75	1.62*
Food & Drinks	2.05	2.02	1.72	.90*
Cloth & Footwear	2.19	1.76	1.84	1.63*
Housing	1.71	2.14	1.64*	2.10
Durables	1.64*	2.26	1.42*	2.07
Health & Medicine	2.21	2.01	2.19	2.04
Transport	2.05	1.99	1.85	1.90
Education & Recreation	2.52*	2.31	2.52*	2.32**
Other "Non Food"	2.42*	2.28	2.09	1.55*

(1) Durbin-Watson statistics are obtained after ordering cases in an ascending order by size of the independent variable, i.e. total expenditure per person.

For starred d^{*} values the null hypothesis that the errors are not serially correlated cannot be accpeted at 5% significance level. For ** the test is inconclusive.

TABLE 4.12 : Income elasticities based on four Alternative Engel Curves (at mean value)

Commodity \ Form	Linear	Double-log	Semi-log	Log-inverse
Cereal & Cereal Products	0.561	.474	0.618	0.288
Root Crops & Pulses	1.286	1.117	1.342	0.801
Milk & Dairy Products	1.00	1.444	1.212	1.200
Oils and Fats	0.636	.759	0.843	0.554
Meat	1.013	1.232	1.177	0.919
Fish	1.500	0.258	0.841	0.194
Vegetables	0.781	1.047	0.970	0.812
Fruits	1.444	1.395	1.442	1.046
Sugar	0.660	0.998	0.841	0.812
Tea & Coffee	0.550	0.702	0.739	0.530
Other Food Stuff	0.750	0.806	0.889	0.530
Drinks	2.143	0.218	1.936	0.088
Tobacco	1.375	0.728	1.542	0.499
Wheat Bread	1.375	1.226	1.556	0.748
Food & Drinks	0.808	0.871	0.950	0.610
Cloth & Footwear	1.118	0.993	1.169	0.668
Housing	1.000	1.240	1.183	0.914
Durables	2.00	0.923	1.900	0.584
Health & Medicine	1.375	0.816	1.527	0.622
Transport	2.103	1.067	1.998	0.739
Education & Recreation	1.070	1.182	1.236	0.878
Other "Non Food"	1.962	1.289	1.899	0.879

Note: The elasticities are obtained using the results of the regressions shown in Table 4.9.

obtained from the different models. Thelog-inverse consistently gives the lowest estimates for both food items and the commodity groups. For the food items with the exception of fish, drinks and tobacco, the estimates of the double-log and log-inverse are close to each other, the difference between the estimates lies in the range of .04 to .30. Looking to the estimates of the double-log the following pattern is observed:

1. Income elasticity of demand for food is less than unity which implies that the proportion of total expenditure allocated to food decreases as income increases.

2. The income elasticity for housing and the other "Non Food" category exceeds unity but one lies inside the 95 per cent confidence interval for the estimated coefficients.

3. For cloth and footwear the income elasticity is not significantly different from unity at 5% level of significance and hence the proportion of expenditure allocated to this category would remain constant as income rises.

4. For transport, education and recreation, the income elasticity is greater than unity but is not significantly different from one at 10% level of significance.

For the food items we find:

1. Income elasticities for milk, meat, fish and fruits exceed

unity and are higher than those for food grains which for most rural areas is composed mainly of dura and its products and within the category of cereals the income elasticity for wheat products exceeds unity.

2. The income elasticity of demand for root crops and pulses is slightly above unity. However one lies inside the 95 per cent confidence interval for the estimated coefficient.

3. The income elasticity of demand for tea and coffee and for sugar is less than unity. However for sugar, one lies inside the 95 per cent confidence interval for the estimated coefficient.

4. Judging from the elasticities estimated for tobacco and drinks using the linear form which fits better than all other forms, the proportion of expenditure spent on these two items increases with rising income.

As we explained the regression coefficients presented in Table 4.9 and the elasticities in Table 4.12 which are derived using these coefficients are obtained using variables in per capita term by deflating by household size. It is explained that this is one way of incorporating the effect of household size in the analysis. This approach, however, has some limitations. It ignores that need varies with age, e.g. children need less than adults. It also ignores the possibilities of economies of scale in consumption. Indeed, the approach assumes constant returns to scale in consumption. Writing consumption on commodity i, Z_{ih}, as a function of total outlay Z_h and household size n

$$Z_{ih} = f(Z_h, n) \qquad (18)$$

f is said to be homogenous of degree one if $f(\lambda Z_h, \lambda n) = \lambda f(Z_h, n)$. Expressing (18) in per capita terms gives

$$Z_{ih}/n = g\left(\frac{Z_h}{n}\right) \qquad (19)$$

Another approach is to introduce the variation in needs of persons of different age and sex explicitly and to express the variables in adult equivalent terms. This approach is based on nutritional standards and expresses the need of varying members as a fraction of an adult male. In a study on food and nutrition in Gezira, Taha (1977, p.81) used the following man equivalent coefficients :

TABLE 4.13 : Formula of Adult Equivalent Scales

Age in Years	Food consumption unit
Adult man	1
Adult woman	.9
14-16	.8
12-14	.7
10-12	.6
Under 10	.5

In order to measure the size of the family in adult equivalent terms we used the following coefficients :

Age in Years	Man coefficient
Adult man	1
Adult woman	.9
8-14	.7
7	.5

Though the scales in Table 4.13 are, in principle, based on nutritional "requirements" determined by experts, they could also be determined behaviourally (Prais and Houthakker, 1971; Brown 1954; Muellbauer, 1977). Using a simple hypothesis in section 4.6 an attempt will be made to measure the effect of household composition on consumption. For the moment the income elasticities which are estimated from regressions using variables measured in terms of adult equivalent are shown in Table 4.14.

Comparing the elasticities which are obtained when values are measured in units per person (Table 4.12) and per adult equivalent (which are shown in Table 4.14) we find that the difference between estimates of elasticities obtained from any one form is not substantial. For food items there is only a small difference between the estimates of elasticities obtained from alternative forms (comparing corresponding columns in Table 4.12 and 4.14), the differences lying in the range .01 to 0.1. For any one of the forms when commodities for which a difference in the estimated elasticities of .10 are excluded (these are tobacco in the linear form; milk and products, drinks and fruits in double-log; root crops and pulses, fruits, drinks and tobacco in semi-log; milk and fruits in the log-inverse) the difference in the elasticities estimated will be in the range of .01 to .06. The elasticities obtained when values are measured per adult equivalent are

higher for root crops and pulses and for milk and products (on the basis of forms other than the linear), and lower for drinks, tobacco and fruits (on linear form basis) than those obtained when variables are measured per person .

The above analysis of the consumers budgets in the rural areas of the Central Region in Sudan and the income elasticities derived from these budgets indicate what the consumers in these areas actually do consume and how they would change their consumption with changes in income. A significant outcome which emerged is that consumer's preferences approach the nutritional standards as income rises, i.e. the pattern of consumption in rural Sudan is that with rising income consumers will tend to spend a lower proportion of their budgets on staple food crops (cereals), which at present takes the largest percentage share of the total food consumption, and an increasing proportion on food that is rich in protein content and vitamin C such as fruits, vegetables, meat, fish and milk. The importance of this result can perhaps be appreciated when we listen to what Mrs.Culwick has written over thirty years ago after a careful study of nutrition in Gezira Scheme,

> "the most important conclusion emerging from the records, after allowances have been made for their defects, is that four danger points are common to all these diets - calcium, vitamin A, riboflavin and vitamin C. And they all lead to the same answers - milks and gardens". (Culwick, 1951, P.128)

And who rightly concluded "the survey result hammers home the fundamental

TABLE 4.14 : Income elasticities based on four Engel Curves
(at mean value)

Commodity \ Form	Linear	Double-log	Semi-log	Log-Inverse
Cereals & Cereal Products	.595	.436	0.618	0.256
Root Crops & Pulses	1.267	1.153	1.449	0.830
Milk & Dairy Products	1.052	1.536	1.263	1.206
Oils & Fats	0.70	0.743	0.844	0.554
Meats	1.025	1.242	1.207	0.940
Fish	1.500	0.224	0.815	0.184
Vegetables	0.836	1.057	1.017	0.829
Fruits	1.400	1.487	1.518	1.137
Sugar	0.641	1.011	0.826	0.858
Tea & Coffee	0.500	0.664	0.698	0.515
Other Food Stuff	0.760	0.809	0.950	0.572
Drinks	1.714	0.144	1.786	0.033
Tobacco	1.188	0.738	1.646	0.532
Wheat Bread	1.375	1.293	1.615	0.794
Food & Drinks	0.817	0.859	0.961	0.610
Cloth & Footwear	1.118	1.049	1.205	0.715
Housing	1.033	1.287	1.233	0.969
Durables	1.944	0.984	1.951	0.648
Health and Medicine	1.375	0.874	1.597	0.669
Transport	2.310	1.193	2.555	0.862
Education & Recreation	1.120	1.258	1.291	0.057
Other "Non Food"	1.803	1.323	1.883	0.917

Note: The income elasticities are derived using the coefficients obtained from a regression of expenditure per adult equivalent on the commodities listed on the total expenditure per equivalent adult using 200 observations .

lesson that the primary limiting factor in matters of diet is economic necessity" and that

> "conditions in the scheme today demonstrate the very considerable extent to which, given reasonably good food patterns at the top of the social ladder, dietary improvement may follow spontaneously in the wake of purely economic development not directly concerned with food nutrition at all" (p.144)

It might as well be argued that policies of economic development which pursue the aims of raising the income and living standards could promote this through a policy of encouraging production of agricultural commodities with high income elasticities. A number of reasons will make this clear. The agricultural commodities which show an expanding demand with rising income like milk, meat, fish and vegetables are labour intensive. Rising consumers incomes provide farmers with a market for greater production of those commodities and thereby allow much greater output and labour utilization per feddan. This would eventually raise incomes of the farming community by providing a productive outlet. Secondly by consuming a more nutritious food this will lead to an improvement in health, the vigour and pace of activities with a favourable impact on productivity, output and incomes. On the other hand if production of agricultural commodities which have high income elasticity of demand lag behind the demand for these commodities, their prices will increase, the extent of this increase depends on the price elasticity of supply for such goods. This could in turn lead to a reduction of consumption of these commodities by the poorer sections or else to an increased demand for substitutes which might be less nutritious or which are imported, e.g. dry milk for fresh produced milk.

Regarding the production of certain commodities like vegetables and animal products in the central area, it is worth mentioning that in the Gezira Scheme, with its over two million feddans of cultivated area, the amountof land which was allocated to vegetables for example in 1970/71 season was 4.12% of the total final cropped area. Animal fodder (lubia) took only 8.2% of the final cropped area. On the other hand the amount of animal available in Gezira has been estimated in 1964/65 (Rahim, 1966) together with the influx of animal brought to Gezira by cotton pickers during cotton harvest season to be as follows

	Main Gezira	Influx
Cattle (head)	73129	7250
Sheep	123589	53064
Goats	103915	25179
Camels	2349	-
Donkeys	33952	-

In fact animals raised by households make a considerable contribution in the consumption of milk and its produce. For the households residents in Gezira in our sample, home produced milk and dairy amounted to 54.88 per cent of the total value of consumption expenditure on milk and dairy products. The figure for White Nile and Blue Nile is 58.57% and 26% respectively. Despite this fact we find that at the present the number of dairy farms operating in modern lines in Gezira is only 49 and these are limited in their services by the high cost of fodder and concentrates and the unavailabilities of skilled manpower in animal husbandry (Taha, 1977, p.21).

Recognition of the role of the livestock in the lives of

people in Gezira and as a means of improving the tenant's livelihood and their diet which was found to lack sufficient protein as early as the 1950's has led some people in the Social Development Department and the Agriculture Research Centre in the Gezira Scheme to advocate mixed farming and cooperatives production in the area. However, considering the vital place which Gezira Scheme occupies in the Sudan's economy, mainly through its contribution to the country's main export, cotton, this contention, it seems, would remain as a proposition for a time to come.

As well as promoting theproduction of goods that seems desirable from the standpoint of economic development policy for the economic well-being of the individual and his nutritional status, there are certain commodities which have high income elasticities that would seem undesirable components in the household's budget. Tobacco is an example in question. According to the linear form the estimated income elasticity is 1.37. Figures presented in Table 4.4 show that for expenditure levels equivalent to or less than 600 pounds, tobacco takes about one per cent in the total food expenditure which is higher than the share for fruit which is only 0.7 per cent. The corresponding figure for expenditure levels greater than 1200 pounds per annum is 2.09 more than twice the percentage share of fruits. Taxation could be relied on as a means of shifting consumption away from such commodities by raising their prices. However if tobacco has a low price elasticity this would require substantial increases in the taxes in order to produce an effective result.

The rates of growth of production for certain agricultural

commodities for the years 1976/79 are shown in Table 4.15. The table shows also the projected rates of growth in production that are provided in the six year plan 1977/83 which bases its projection on expected demand.

Comparing the projected rates with the rates of growth in 1976/78 (in the year 1978/79 of the six year plan the economy was affected by problems of fuel shortage which coincided with rains and floods) it is apparent that except for groundnuts and dura the projected rates exceed the actual rates. So judging from past rates of growth it is probable that supply will fall short of demand. Another thing to note is that for wheat for which one would expect demand to expand with rising incomes (unlike demand for dura) the rate of growth is far behind the target and in the period 1976/79 it showed a large negative growth rate. Of course one way in which the deficit in production is to be met is through importation of the goods. The government, however, seems to have expected attainment of self-sufficiency in production of some of these commodities in few years. For instance according to the six year plan the country would have attained self-sufficiency in the production of wheat in 1978/79. This has not been realized and the importation of wheat and wheat flour continued throughout the years of the plan. In fact production of wheat has been surrounded by a number of problems.

As a result of an emphasis in both the Ten Year Plan for Economic and Social Development (1961/62-1970/71) and the Five Year Plan of Economic and Social Development (1970/71-1974/75), the amount of land under wheat in both Gezira and Khashm El Qirba schemes, where

TABLE 4.15 : Rates of Growth of Output for Certain Commodities 1976/79 and Projected Increase in the Period 1977/1983

Commodity	(1) 1976/78	(1) 1976/79	Projected (2) 1977/1983
Sarghum (dura)	-	15	12
Wheat	8	-22	13.6
Groundnut	31	-.5	11
Sesame	-.6	-6.6	7.7
Fruits	8	8	-
Vegetables	5	3	-
Meat	5	4	7.4
Milk	3.5	2.6	5.2
Fish	3.9	3.0	8.8

(1) Source : Agricultural Section, Ministry of Planning, Recent Performance of the Agricultural Sector (Khartoum, 1979), computed from the Statistical Annex, Table 8.1

(2) Source : Ministry of Planning, The Six Year Plan for Economic and Social Development 1977/78-1982/83. Volume II (Khartoum, 1976), p.11.

it is mainly grown, has been growing continuously since the 1960's. In Gezira scheme area has been growing from 5,025 feddans in 1960/61 to 122,829 in 1970/71. In Kashm El Qirba area has grown from 32,551 in 1964/65 to 109,000 feddans in 1971/72. This increase in area, however, has not been accompanied by an increase in productivity per feddan. A number of reasons were offered as an explanation of the low yield per feddan. It has been found that the low yields per feddan is the result of untimely operations (late sowing) and insufficient watering for which wheat competes with other crops in Gezira. Pests and diseases, inadequate fertilizers and high costs of inputs like seeds, fertilizers and labour are among the other reasons offered (Faki and El Hadari, 1974). Gezira mission study by the International Bank for Reconstruction and Development regarded wheat as a completely

non-profitable crop (IBRD, 1966, pp.4-5).

Faki and El Hadari(1974) after studying a sample of plots in both Gezira and Khasm El Qirba conclude

> "there is still some scope to remedy the present situation by increasing yields and decreasing costs of production. One of the main factors that help to improve yields is through the promotion and implementation of improved cultural practices. In this respect an efficient extension service is needed to persuade farmers to the importance of such practices. This will help narrow the gap between farm and research yields. Additional improvements in yields can be achieved through new introductions of better varieties and high technology of fertilizer and water application" (p.53)

It appears therefore that a number of problems would be encountered in taking advantage of the favourable expansion in demand for commodities which have a high income elasticity. First increased output of these products involve intensification of production which would require more capital. Secondly a change in type of farming or even expansion of small segments would place a special burden on management ability and in the requirement for skilled and trained man-power. And if such expansion is to be achieved it will require special extension services. A third problem is that of marketing. Some of the commodities with high income elasticities have a complex marketing feature. Problems of bulk and perishability could be cited in this respect for livestock and its products where the production centres in Sudan lies at a distance (western areas) from urban consumption centres.

4.5 The Household Composition Effect

In the last section income elasticities were estimated using cross-section data in such a way that these elasticities are not confounded by the effects of households compositions. The method which is used consisted of measuring the variables in per head terms and per adult equivalent term. The equation which expresses the household expenditure or consumption per adult equivalent as a function of the amount of income per equivalent adult in its general form looks as follows

$$\frac{Z_{ih}}{\Sigma_j \delta_j m_{jh}} = f\left\{\frac{Z_h}{\Sigma_j a_j m_{jh}}\right\} \qquad (20)$$

which we may write as

$$\frac{Z_h}{m_i} = f\left\{\frac{Z_h}{m_o}\right\} \qquad (21)$$

where $m_i = \Sigma_j \delta_j m_{hj}$ and $m_o = \Sigma_j a_j m_{jh}$.

The symbols have the following meaning:

Z_{ih}	is the expenditure on or consumption of the ith commodity by hth household.
Z_h	is the total income of the hth household
m_{jh}	is the number of persons in the hth household belonging to the jth age-sex group.
δ_{ij}	are coefficients depending on the ith commodity and the jth age-sex group but assumed identical for all households
a_j	are coefficients depending only on the jth age sex group

and are assumed constant for all households.

The characteristics of this equation has been discussed by Houthakker (1952) and by Prais (1952, 1953). Whereas in Section 4.4.2 use was made of extraneous information to determine the coefficients δ_{ij} (where δ_{ij} is assumed equal δ_j) and hence the scales m_i, it is quite possible that these scales be derived from the budget data. This can be illustrated in the following manner (Brown, 1954). Assuming that we are using a double-log form, the explicit formulation of (20) is

$$\frac{z_{ih}}{\Sigma_j \delta_{ij} m_{jh}} = A_i \left\{ \frac{z_h}{\Sigma_j a_j m_{jh}} \right\}^{B_i} e^{u_{ih}} \qquad (22)$$

Taking samples of households of constant composition defined by the set of numbers $(m_1 \ldots m_t)$, then for the kth sample the denominators on the L.H.S. and R.H.S. may be replaced by constants, $m_{ik} = \Sigma_j \delta_{ij} m_{jh}$ and $m_{ok} = \Sigma_j a_j m_{jh}$ and the double-log form in (22) may be written as

$$z_{ih} = (A_i m_{ik} m_{ok})^{-B_i} z_h^{B_i} e^{u_{ih}} \qquad (23)$$

Fitting the equation

$$z_{ih} = d_{ik} z_h^{g_{ik}} e^{w_{ih}}$$

we see that

$$d_{ik} \text{ estimates } (A m_{ik} m_{ok})^{-B_i} \qquad (24)$$

$$g_{ik} \text{ estimates } B_i \qquad (25)$$

Taking (24) and (25) together means that the elasticities obtained for each type of household should be the same, within sampling error, and the validity of the hypothesis can be tested with the variance ratio tests and tests for the homogeneity of variances (see for example Forsyth (1960)). Thus by applying (21) to a group of households of the same composition but of varying household incomes, an estimate may be obtained of one of the parameters of the Engel curve which is completely free of the effects of household composition.

Now equation (22) may be written to give the following expression

$$x_{ih} \equiv z_{ih}\left[\frac{\Sigma_j a_j m_{jh}}{z_h}\right]^{B_i} = A_i(\Sigma_j \delta_{ij} m_{jh})e^{u_{ih}} \qquad (26)$$

in which x_{ih} may be regarded as expenditures corrected for differences in the standard of living. The formulation in (26) imply that the cost of buying commodity q_i ($Z_{ih} = P_i q_i$) is a function of both total expenditure and the household characteristics. Using the estimated coefficients B_i the α_{ij} could then be estimated by ordinary least squares method. In the absence of a_j estimates (the income equivalent scale) the scale chosen for calculation is usually one in which all a_j are equal i.e. using income per person as a measure of the standard of living (Brown, 1954; Prais and Houthakker, 1955).

Attempts to estimate the Prais-Houthakker model in (20) gives rise to problems of identification. Intuitively the problem is that we are trying to identify n parameters m_i, which vary with household composition, by examining n different Engel curves. But Engel

curves must satisfy the adding-up restriction, and so will yield only n-1 independent pieces of evidence. This leaves one short for the full identification of scales.

Forsyth (1960) suggests a simple hypothesis for estimating the household composition effect only. If the latter is all we are interested in measuring equation (21) may be written as

$$\frac{Z_{ih}}{m_i} = f(Z_h) \tag{27}$$

Assuming that the household composition effect is to be determined relative to a standard family (a family with no children) m_i could be expressed as follows

$$m_i = (1 + \frac{m_t}{c})^{d_i} \tag{28}$$

where m_t is the number of children in the family and the constant c is assumed to equal 2 for the standard family. We should note that the expression in (28) implies that there is no difference in the requirement of children in different age-sex groups.

Incorporating (28) in the double-log form which fitted the data best in the last section we will have

$$\frac{Z_{ih}}{(1 + \frac{1}{2} m_t)^{d_i}} = A Z_h^{B_i} \tag{29}$$

or alternatively

$$Z_{ih} = AZ_h^{B_i}\left(1 + \frac{m_t}{2}\right)^{d_i} \qquad (30)$$

Taking logs of both sides

$$\log Z_{ih} = \log A + B_i \log Z_h + d_i \log\left(1 + \frac{m_t}{2}\right) \qquad (31)$$

The parameters B_i and d_i could then be estimated using ordinary least squares. We fitted equation (31) for a sub sample of the households we have. These are the households in which the family is composed of a couple and of children only; the latter are defined as members in the family who are fourteen years of age or less. We had 75 households of this type in the data.

After estimating d_i the household equivalence scales m_i are derived for families without children, with 2, 3, 4, 5 and 6 children by substituting the number of children for m_t and using the estimated coefficient d_i in equation (28). These are shown in Table 4.16 under the headings H, H + 2, H + 3, H + 4, H + 5 and H + 6.

The scales show that families with two or more children compared to childless families always realize a proportionate increase in its total expenditure for the group of commodities shown. They also indicate that this increase occurs with a decreasing rate as the size of the family increases. The highest proportionate increase in total outlay occurs for commodities which have an income elastic demand e.g. wheat bread, milk. For instance a family with two children

compared to a standard family will require 57 per cent increase in its total outlay on wheat bread. The corresponding figure for milk is 34 per cent.

TABLE 4.16 : The Total Effect of Family Composition Estimated from Double-log Model

Family Type / Commodity	H	H + 2	H + 3	H + 4	H + 5	H + 6
Cereal & Cereal Products	1	1.30	1.52	1.52	1.61	1.69
Milk & Milk Product	1	1.34	1.48	1.60	1.71	1.81
Oils & Fats	1	1.11	1.15	1.18	1.21	1.23
Meat	1	1.11	1.14	1.17	1.21	1.23
Sugar	1	1.26	1.35	1.44	1.51	1.58
Tea and Coffee	1	1.13	1.18	1.22	1.25	1.28
Wheat Bread	1	1.57	1.81	2.04	2.26	2.46
Durables	1	1.39	1.55	1.69	1.82	1.95
Education & Recreation	1	1.32	1.44	1.55	1.65	1.74
Other "Non Food"	1	1.18	1.25	1.30	1.35	1.39

Note: The values are the relative levels of family expenditure predicted by the model in equation (29) for changes in family size. They are constant at all levels of income and for the above commodities they constitute a scale of equivalent families.

4.6 The Distribution of Expenditure, Income and Taxes

In the above section we looked at the determination of demand for the various commodities as influenced by the total income of households. In this section we will look at the distribution of total income of households, y, which is furnished by the Household Budget

survey and the distribution of total outlay on consumption by the households, Z_h. As we mentioned before income measured by the survey can not be taken as a precise estimate of the "normal" permanent income of the households in the sample because of its inclusion of transitory elements and problems of measurement and under-estimation or over-estimation which usually arise in such surveys. This is in fact confirmed by inspection of monthly incomes over the twelve months of theyear which showed that for some units there are large variations in some of the months that cannot be explained by the seasonal variation in income that could have resulted from realization of earnings from the sales of products or which correspond to the harvesting of agricultural produce.

The total income and expenditure of the household does include income in kind received from employers or produced at home. In the household budget survey income in kind and home-produced consumption are usually valued at the prevailing market prices. Thus some of the variation in income or consumption across the year for an individual unit may be attributed to the variation of prices. In some cases, however, the household received large sums of money from members working abroad and these are included in the valuation of income of the household.

Our concern with income distribution stems from the fact that the income distribution directly determines the commodity demand through the consumption pattern. Income distribution is of interest also because it has an implication for government policies regarding the scope of public intervention in the factor and product markets through the creation of an egalitarian distribution. The process

of interaction between income distribution, production, consumption and factor allocation is described by the ILO (1976b pp.49-50) thus:

> "High and growing inequality of income generates rapidly increased demand for luxury goods (in particular, expensive consumer durables) but relatively sluggish growth of effective demand for basic foodstuffs and consumer goods. Increased productive employment and higher incomes for the poor will change both the level and rate of growth of demand for basic consumer goods and public services. The shift in composition of demand should induce a shift in the pattern of production towards goods which in many cases are more suitable for production on relatively small scale. This may tend in turn to generate higher levels of productive employment, to the extent that the output mix is characterized by greater labour intensity".

So our second aim will be to look at the extent to which the prevailing tax system in rural areas has an impact in reducing income inequalities. For this purpose an examination of the post-tax income will be provided

We have used as an index of inequality the Gini coefficient which was introduced in Chapter 3. Here we define it as

$$G = 1 + \frac{1}{n} - \left\{\frac{2}{n^2\bar{y}}\right\}\left\{y_1 + 2y_2 + 3y_3 + ny_n\right\}$$

where n is the number of individuals, y_i is the income or total outlay of individual rank i ($y_1 \leq y_2 \leq y_3 \leq \leq y_{n-1} \leq y_n$), and $\bar{y}$ is the mean income or mean total expenditure. As we mentioned above the distribution of expenditure and income will be measured for the household unit. The household budget survey defines the household as the group of people sharing common cooking and sheltering facilities.

In rural areas the household would often be composed of more than one family sharing production and consumption decisions together. Larger households may therefore have higher incomes. Thus household size-distribution may indicate more inequality than per capita size-distribution. One should bear in mind, however, that it does not necessarily follow that a positive correlation between income and household implies that per capita size-distribution indicates less inequality than household size-distribution.

In the following analysis the distribution of expenditures and income will be presented for the 200 households used in previous analysis. The distribution of total expenditure for the households is shown in Table 4.17.

According to the distribution of total expenditure in Table 4.17, the bottom 20 per cent households had a share of 7.79 per cent of the total expenditure in the sample. On the other hand the top 20 per cent share in total expenditure reached 41.07 per cent. This degree of inequality is summarized by a Gini coefficient of about 0.5.

The distribution of total income is given in Table 4.18.

TABLE 4.17 : Distribution of Total Expenditures

Decile	Rank Order of Households in decile (Bottom = 1, Top = 200)	Expenditure of decile (Pounds)	Share in Total	Cumulative Expenditure	Share in Total
(Bottom) 1	1 - 20	4086	2.86	4086	2.86
2	21 - 40	7297	5.11	11383	7.97
3	41 - 60	8663	6.06	20046	14.03
4	61 - 80	9698	6.79	29744	20.82
5	81 - 100	10963	7.67	40707	28.49
6	101 - 120	12562	8.79	53269	37.28
7	121 - 140	14188	9.93	67457	47.21
8	141 - 160	16775	11.74	84232	58.95
9	161 - 180	21046	14.73	105278	73.68
(Top) 10	181 - 200	37639	26.34	142917	100.02(1)
Gini coefficient = .498					

(1) Figure may not add exactly to 100 because of rounding errors.

TABLE 4.18 : Distribution of Total Income

Decile		Rank Order of Households in decile (Bottom = 1, Top = 200)	Income of decile (Pounds)	Share in Total	Cumulative Income	Share in Total
(Bottom)	1	1 - 20	3851	1.73	3851	1.73
	2	21 - 40	6889	3.09	10740	4.82
	3	41 - 60	8773	3.93	19513	8.75
	4	61 - 80	10052	4.51	29565	13.26
	5	81 - 100	11636	5.22	41201	18.48
	6	101 - 120	14002	6.28	55203	24.76
	7	121 - 140	16339	7.33	71542	32.09
	8	141 - 160	20351	9.13	91839	41.21
	9	161 - 180	29412	13.19	121305	54.41
(Top)	10	181 - 200	101713	54.61	223018	100.01
Gini Coefficient = 0.519						

TABLE 4.18 : Distribution of Total Income

Decile		Rank Order of Households in decile (Bottom = 1, Top = 200)	Income of decile (Pounds)	Share in Total	Cumulative Income	Share in Total
(Bottom)	1	1 - 20	3851	1.73	3851	1.73
	2	21 - 40	6889	3.09	10740	4.82
	3	41 - 60	8773	3.93	19513	8.75
	4	61 - 80	10052	4.51	29565	13.26
	5	81 - 100	11636	5.22	41201	18.48
	6	101 - 120	14002	6.28	55203	24.76
	7	121 - 140	16339	7.33	71542	32.09
	8	141 - 160	20351	9.13	91839	41.21
	9	161 - 180	29412	13.19	121305	54.41
(Top)	10	181 - 200	101713	54.61	223018	100.01
Gini Coefficient = 0.519						

The minimum income recorded by the survey is 66 pounds per annum while the maximum income is 13722 pounds. As Table 4.18 indicates the bottom 20 per cent of the population had a share only of 4.82 per cent of the total income. The corresponding share of the top 20 per cent is 67.80 per cent. This degree of concentration is reflected in a Gini coefficient of about 0.52. Ali (1977, 1978) has computed the Gini coefficient for Sudan for the years 1955/56 and 1967/68 and for the Northern Province for a sample of villages as 0.336, 0.420 and 0.289 respectively. Thus it seems that the income distribution distribution in Central Region it appears more unequal compared to the findings for Sudan as a whole and for the Northern Province.

Having looked at the distribution of income we now ask the question : to what extent has the government or governments (local) fiscal policies affected the observed income distribution. In other words we will be concerned with the effects of currently prevailing taxes or the effective incidence of taxation. To quote Ursula Hicks (1946, p.159)

> "In order to discover the full consequence of a tax we have to draw and compare two pictures - one of the economic set up (distribution of consumers' wants and incomes, and allocation of factors), as it is with the tax in question in operation, the other of a similar economic set-up, but without the tax. It is convenient to call the difference between these two pictures the Effective Incidence of the tax".

But before answering the above question we need to give an account of the direct taxes which are reported in the household budget's questionnaire and in particular to those which are directly

relevant to the agriculturists in the rural areas of Central Region. The questionnaire reports the direct taxes actually paid by the household. These will be used to measure the post-tax income and present its distribution later.

A number of these direct taxes are related to crops or animals in the rural sector and were initially levied, collected and the revenue retained by the central government until 1951 when they were transferred to the local governments which now levy, collect and retain the funds from these taxes for their budgets. These direct taxes consist of ushur (tithes), a land tax and an animal tax. (These taxes will be discussed in detail below). A tribute tax which is a collective tax was used to assimilate ushur and animal tax and until recently was relevant to lightly administered areas on a tribal basis. Beside these direct taxes which are locally administered there are other direct taxes which are imposed by the Local Councils but they are of lesser importance in local Rural Council's budgets. These include the local rates and fees. A direct tax which is levied, collected and the proceeds from which retained by the central government is the income tax and the stamp duty. The income tax was introduced in Sudan for the first time in 1964. It is a consolidated tax of three taxes developed separately until 1967, when they are unified in one income tax. These are the business profit tax introduced in 1913, the personal income tax introduced in 1964 and the land rent income tax introduced also in 1964. According to the Income Tax Act 1971, amended 1972, the income tax is charged each year upon the income tax which (a) is derived from the Sudan or elsewhere in case of a resident person (an individual or enterprise or legal entity) and

(b) income which is derived from the Sudan in the case of a non-resident person. One would expect the contribution of the agricultural sector to the income tax to be small because the latter is imposed mainly on the income of large companies in the modern urban sector and which keep proper accounts and on individuals who earn their income and pay their tax through the system P.A.Y.E. (pay as you earn) (Numeri, 1974; Suliman, 1975). The income tax is also characterized by a high exemption unit, which is equal to 300 pounds for the married or the widow with children and 200 pounds for the single. Moreover in large corporations in the agricultural sector the government obtains income directly in the form of its share in these enterprises, e.g. Gezira Scheme. It is also plausible to except the contribution of the rural sector as a whole to the income tax to be of lesser importance than that of the urbanized sector. This is supported by Table 4.19 which shows the occupational distribution of the economically active population in rural Sudan and in rural Central Sudan.

Thus most of the rural population is occupied in agricultural activities and in the services, sales and production sector. In the sample which we have all the people who are in the category of the services, sales and production are self employed.

As a matter of fact, the contribution of direct taxes on net income and profit is only a small percentage of the total central government revenue. This is a reflection of both the small importance of corporate sector in the economy and of the narrow coverage of the personal income tax. For instance in 1974/75, the contribution of the direct taxes on income to the total revenue collected by the central government is only 10.33% (see Table 4.21). In here we will

TABLE 4.19 : Economically Active Population by Occupation in Rural Sudan

Occupation	Rural Sudan	Rural Central Sudan
Agricultural and Animal Husbandry Workers	77.36%	70.08%
Services, Sales, Production and Related Workers	11.72%	16.45%
Clerical, Administrative, Managerial, Professional and Technical Related Workers	2.14%	2.80%
Others not Classifiable by occupation	8.78%	10.67%
Total	100%	100%

Source: Department of Statistics, Sudan Second Population Census 1973 (Khartoum, 1977), computed from Table 25(c), pp.174-175.

talk in more detail about the agricultural direct taxes proper.

(1) Ushur (tithes) : Imposed under the taxation of Rain Lands (Ushur) Ordinance 1924. Ushur is a tax on crops grown on land watered periodically by rain or river on which no land tax or rent in lieu of land tax is levied. As the name implies it amounts in principle to one-tenth of the crop on which it is imposed. A maximum of 15% of the total value of the crop is specified in 1924 Ordanance. The tax rate is fixed by the local authorities after the consent of the Minister of Local Governments. The tax rate varies between one province and other and within provinces between one rural council and another.

The assessment of the tax is a laborious task and it entails inspection of the ripening crops by village committees which comprise selected local authorities and the village head, who estimate areas and yields and record the figures in lists against the names of the cultivators. The total crop will then be translated into value using the prices fixed by the Province Governor and the tax yield will be estimated according to the fixed rates. Owing to the variation in rainfall in different localities from year to year and other climatic conditions, the revenue from this tax is always a fluctuating one.

(ii) Land Tax : Imposed under the Taxation of Land and Date Trees Ordinance 1925. It is a cultivation tax on land other than land dependent on rainfall. Land tax is applied in three ways:

(1) A tax on land irrigated by saqiya (Persian Wheel) and shaduf. Rates are set by local authorities provided they do not exceed a maximum of two pounds per feddan.

(2) An amount of one and a half pound per feddan on agricultural schemes irrigated by small pumps (the pump having a suction pipe less than 10 in. in diameter)

(3) 12% on the actual gross value of the crops produced by schemes irrigated by large pumps (the pump having a suction pipe of more than 10 in. in diameter).

In the case of small cultivated units using traditional methods of cultivation (saqiya, shaduf) or small pump schemes the tax is assessed on the basis of the size of cultivated land. For large

schemes the tax is estimated every year on the value of produced crops assessed by inspecting committees.

(iii) Animal Tax : Imposed under the Taxation of Animal Ordinance in 1901 and revised in 1903 and again in 1925. The law set a maximum rate which varies from ten piastes on goats to one pound on camels. The actual rates however differ from the maximum rate and varies from one area to another, being higher in areas which are rich in animal wealth.

The revenue from the tithes is an important constituent part in the budgets of rural councils that are situated in areas of rainfed cultivation. Land tax on the other hand is important in areas of irrigated cultivation. For example the revenue from land tax in Kosti Rural Council (in White Nile Province) constitutes about 50% of the total revenue. In Sennar (in Blue Nile) the land tax revenue accounts for more than 50% (Suliman, 1978). The significance of ushur in the budgets of rural councils in rainfed cultivated areas can be seen from Table 4.20 which shows the land tax, ushur, animal tax and total revenue from all taxes for the Shukrya (Ruffa'a) Rural Council (Gezira Province) between the years 1951/1959.

Beside the direct taxes on the rural population as producers of goods and services, there are of course the indirect taxes which they pay in their capacity as consumers. These indirect taxes comprise the excise duties on locally produced goods, the import and export duties and the profits from sugar monopoly. All these taxes are levied by the central government. Sudan, like many other developing countries

TABLE 4.20 : Direct Taxes (in Pounds) in Ruffa'a Rural Council 1951/59

Year	Land Tax	Ushur	Animal Tax	Total Revenue
1951/52	570	2284	7197	27608
1952/53	559	15190	3598	31149
1953/54	807	7069	7197	34256
1954/55	742	5536	7173	34024
1955/56	1074	4819	-	36527
1956/57	477	17884	7182	51591
1957/58	883	5460	9252	43054
1958/59	1014	10887	9252	43010

Source: G.M.Salih, Shukrya Rural Council : constitution, Finance and Services (Khartoum, 1959) Table 6 p.40 and Table 8 p.46.

depends on the taxes imposed on exports and imports for much of her revenue. This is due to the importance of the foreign trade sector and the ease of accessibility through taxation. In the year 1974/75 the revenue from import and export duties accounted for 29.81% in the total government revenue. Excise duties contributed 20.8% to the total and sugar profits 6.8% (see Table 4.21). In the 1971/72 period the sugar profits amounted to 10% of the total revenue higher than their contribution in 1974/75. While import duties constitute a significant part in total government revenue their relative importance has greatly declined in recent years giving way to excise duties with an increasing contribution to the central government budget.

It is not one of our objectives to measure the effect of indirect taxes in the consumers budgets in our sample partly because of the difficulties of measuring the amount of the indirect taxes paid by each household particularly when the tax is imposed on a specific basis which would require knowledge of weight of units and the prices, and because a complete study of the effects of taxation would undoubtedly require a separate study by itself. Rather our main aim

TABLE 4.21 : Central Government Revenue by Source 1974/75

		L.S.million	%
1.	Taxes on net income and Profit		
	Income Tax	21.6	10.33
	Stamp duty	2.0	0.95
2.	Pension Contribution	1.1	0.52
3.	Taxes on Production & Consumption		
	Sugar monopoly Profits	14.3	6.84
	Excise and Consumption Taxes	43.4	20.76
4.	Taxes on international trade		
	Import duties	52.6	25.16
	Export duties and Royalties	9.7	4.64
	Transfer and Fees	13.5	6.46
5.	Duties on goods and services	10.9	5.21
6.	Property Receipts (include Profits from public enterprise, participation in agricultural schemes, interest and dividends)	23.3	11.14
7.	Reimbursement and services	8.9	4.26
8.	Miscellaneous	7.7	3.68
	Total	209	100.0

Source: Ministry of Finance and National Economy, Economic Survey 1977/78 (Khartoum, 1978), computed from Appendix 2/1,p.266.

as we mentioned at the outset is to look at the effect of the direct taxes which are reported for the households in the sample we have.

The distribution of post-tax income is shown in Table 4.22

TABLE 4.22 : Distribution of Post-Tax Income

Decile		Rank Order of Households in decile (Bottom = 1, Top = 200)	Income of Decile (Pounds)	Share in Total	Cumulative Income	Share in Total
(Bottom)	1	1 - 20	3848	1.74	3848	1.74
	2	21 - 40	6885	3.11	10733	4.85
	3	41 - 60	8771	3.96	19504	8.81
	4	61 - 80	10038	4.53	29542	13.34
	5	81 - 100	11440	5.17	40982	18.51
	6	101 - 120	13874	6.27	54856	24.78
	7	121 - 140	16131	7.29	70987	32.07
	8	141 - 160	20316	9.18	91303	41.25
	9	161 - 180	29127	13.15	120430	54.40
(Top)	10	181 - 200	100984	45.61	221414	100
Gini coefficient = 0.518						

The Gini coefficient of the after-tax income is 0.518, indicating a reduction of a minor magnitude of 0.001. The direct taxes imposed on rural population seem to have a negligible effect on the overall picture of inequality which we found before. This result is not surprising and some explanations may be advanced why it is so. All the direct taxes levied on the agricultural sector seem to be imposed for the sole purpose of raising revenue for the government and not for any other purpose whatever it could be. The greatest defect of the land tax system is its inflexibility. The same rates have remained in force for decades, although agricultural prices and income have increased considerably. In its most parts the land tax is also a proportional tax per feddan. With a proportional land revenue and a large marketed surplus, the bigger landowners would be lightly taxed. It is also quite possible that the land tax outside the irrigated agriculture (Ushur) could be conceived as a proportional tax per feddan. In the following chapter we will see that for three out of five villages we studied in rainfed land output per feddan is proportional to total cultivated area. Thus a tax of 10% on total value of output will be proportional to the total cultivated area. The animal tax is also proportional to the number of animals owned. Moreover it does not distinguish between an owner who raises animals for domestic needs and one who is a trader and uses his animals for income earning purposes. The other thing is that with no tax in the agricultural sector corresponding to the personal income tax in the modern sector, the income which could be derived by the agriculturists from non agricultural activities would remain untaxed.

Therefore it looks that administrative action is required in

the field of direct taxation in agriculture not only for the taxes to serve the objective of reduction of disparities in income and wealth but if they also are to meet the need of government for raising the revenue that could be used for investment in the agricultural sector or building the necessary infrastructure in that sector. In the short run this action should make its immediate aim the revision of the prevailing rates of taxation and the ways of their assessment.

4.7 Conclusions

We have studied in this chapter the demand for commodity groups and for food consumption items by the households in the rural region of Central Sudan. Experimentation with different functional forms was undertaken with an emphasis for possibilities of the best fit among them of the existing data. We have concluded that the double-log specification passes the tests of goodness of fit fairly well compared to the other functional forms.

We found that food consumption expenditure represents the largest proportion in the budget of families and that this proportion would exhibit a declining trend with rising income as implied by a less than unitary income elasticity of demand for food. The results reported in Section 4.4.2 (ii) indicate that if total expenditure or "income" per capita is increased by one currency unit in rural areas it is allocated approximately as follows: 58% on food, 15% on other "Non Food" manufactured items, 8% on cloth and footwear, 6% on housing, 6% on transport, 3.6% on durables, 2.6% on education and recreation and 1% on health and medicine.

An extended version of the linear expenditure system that allows estimation of minimum subsistence expenditures and price elasticities from cross section data was applied, confining its use to broad commodity groups, leaving the task of application to disaggregated items in the food category to other functional forms. Some statements on the basis of the postulated model of the ELES were made with some elementary caution. The minimum subsistence estimates, γ^*, which may be interpreted as measuring an acceptable minimum standard as perceived by households in the rural community, are found to fall below the cost of expenditure on food that is supposed to give an improved diet after adjusting this cost for price variations. Though it might be argued that increasing the total minimum expenditure on food does not necessarily mean that the households would allocate the expenditure among commodities in such a way that more of the nourishing items of food are consumed, this may not be true for Sudan. Consumption patterns were found to approach the nutritional standards as income rises. Hence one may expect consumption by households to approach the neighbourhood of the set of nutritious bundle of food as income increases. Although our results are not potent enough to justify the application of the minimum subsistence expenditures in definitions of poverty line, the relative magnitude of the estimated subsistence expenditures do offer a guidance on these issues, however qualified. The income and own price elasticity for food were estimated to be 0.69 and -.53 respectively. This can be compared with other studies which used the ELES. For rural Mexico these turned out as 0.68 and -.31 respectively (Lluch, et al., 1977, Table 6.15, p.154).

Income elasticities for other commodity groups and for the

food items were also estimated. These can be used for projections of demand for rural Central Sudan. If these were used for forecasting of demand what would be required is government policies to intervene in the supply side, through planning both the domestic production and imports to affect a balance between supply and demand using the available fiscal policies (taxes/subsidy) and monetary policy. Some of the problems that could be encountered by the government effort in this respect have been pointed out.

The effects of household composition on consumption expenditure was introduced explicitly in Section 4.5, and using a simple hypothesis, households equivalence scales were derived. These as mentioned before are analogous to price indices and could be used to convert the budgets of households of different composition to needs corrected basis.

Income distribution was found to be more unequal compared to findings for Sudan as a whole and for Northern Province. The impact of direct taxation in the income distribution was found to be of minor importance. We attributed this to the characteristics of the direct taxes in the agricultural sector and mainly to the lack of any progressivity in their rates. Our perception is that the land tax is a candidate which could be reckoned with to improve the capacity of the tax system to play its role as a corrective device of inequalities, since land is the most important factor of production and income generation. It is our understanding at any rate that the inability of the taxes to achieve a substantial influence is due largely to the non-taxing of the non-agricultural income.

CHAPTER 5 - Production

5.1 Introduction

In this chapter we address ourselves to the question of output determination. The main aim of our study of production is an assessment of the efficiency of agricultural household. The tools of production function will be used for this aim. Thus in 5.2 we look at the production function approach to the study of efficiency and some of the underlying theoretical difficulties which are bound to arise when attempts are made at empirical assessment of the neoclassical production function. We will also look at an explicit form of the function which has been widely used in the empirical analysis of production and which would be our basic form for the treatment of output analysis. In 5.3 we look at the variables which we are going to use in our model of production. These are the output of crop production and the variables which determine its magnitude. In Section 5.4 we present the empirical study of production and examine its statistical validity and economic and policy implications. In 5.5 we examine whether the production of staple grains is enough compared with some requirements as set by nutritional standards. The concluding remarks are provided in 5.6.

5.2 The Production Function Approach

The production function is a technical relationship between inputs and the quantity of output which these inputs produce. Inputs are assumed to be continuously variable and substitutable in production all the time. Thus if $x_1,\ldots,x_n$ are the inputs which are used in the production process, there corresponds a maximum output y and we

can write

$$y = F(x_1,\ldots,x_n) \qquad (1)$$

The inputs $x_1,\ldots x_n$ are the result of economic considerations which determine their quantity in a manner that maximizes the profit obtainable from the sale of output y. Hence the production function is only one of the constraints which appear in an economic model in which the quantity of inputs and outputs yielded through the use of these inputs are to be determined. Given the assumption of perfect markets where a perfectly elastic supply of factors prevail and where demand for output is also perfectly elastic, the profit maximization problems facing the producer of y is written as

$$\underset{x_1,\ldots,x_n}{\text{Max.}} \quad \Pi = py - \sum_i^n p_i x_i \qquad (2)$$

where P is the price of production y and the P_i's are the price of the inputs. After substituting (1) into (2) the first order conditions for a maximum gives

$$PF_i = P_i \qquad \forall\, i \qquad (3)$$

where F_i is the first derivative of F with respect to x_i i.e. $\partial F/\partial x_i$ and is the marginal product of input x_i. (3) together with (1) gives $n+1$ equations to solve for $n+1$ unknowns (that is: $x_1,\ldots x_n,y$) in terms of the predetermined variables in the model $P, P_1,\ldots,P_n$. According to (3) each input is used in the production process up to the point where it is value marginal product is equated

to its price. It is usually assumed that $Fii = \frac{\partial^2 F}{\partial x_i^2} < 0$. This condition is necessary for the second order conditions of a maximum to hold, so from (3) we can see immediately that, with declining marginal productivity i.e. $Fii < 0$, an increase in the price of any one factor, ceteris paribus, leads to a decline in the use of that factor. The second order condition for a maximum, however, implies that if inputs are changed by a scalar σ, the change in output which results from this would be less than σF, namely

$$F(\sigma x_1,\ldots,\sigma x_{n-1}, \sigma x_n) = \sigma^n F(x_1,\ldots,x_{n-1},x_n)$$

where $n < 1$. This condition means that increasing and constant returns to scale ($n \geq 1$) are incompatible with the model of profit maximization outlined above.[1/] This means that the model of profit

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1/ Consider the Cobb-Douglas production function: $y = e^{\alpha_0} x_1^{\alpha_1} x_2^{\alpha_2}$ where $\Sigma\alpha_i$ indicate the degree of returns to scale. The function will display increasing, constant or decreasing returns to scale according as $\Sigma\alpha_i \gtreqless 1$. Differentiating with respect to x_1 twice

$$F11 = \frac{\partial^2 y}{\partial x^2} = \alpha_1(\alpha_1-1)y/x_1^2$$

If $\alpha_1 > 1$, which necessarily implies $\alpha_1 + \alpha_2 > 1$, that is increasing returns, $F_{11} > 0$ and will be violating the law of diminishing returns (second order conditions will not hold), See Lancaster (1969, pp.309-310). See also Wallis (1973, pp. 33-35). It should be clear, however, that for a firm maximizing profits under uncertainty the case of increasing returns to scale may be compatible with optimization (see Sandmo, 1971).

maximization needs to be reformulated. One way which is suggested (see Cramer, 1973) is to assume that output is a predetermined variable rather than an endogenous one determined within the model. Assuming that y together with $P, P_1, \ldots, P_n$ are the exogenous variables in the model we would have the maximization problem facing the producer

$$\text{Max. } \Pi = py - \Sigma_i^n p_i x_i \qquad (4)$$

The only difference from (2) above is that (4) is equivalent to a minimization of $\Sigma p_i x_i$, which is the total cost incurred by the producer. Then we can write

$$\underset{x_i}{\text{Min.}} \quad \Sigma p_i x_i \quad \text{s.t.} \quad F(x_1, \ldots, x_{n-1}, x_n) \equiv y \qquad (5)$$

The optimal quantities of input that minimize total cost could be obtained by using the Lagrangian multiplier method

$$\Theta = \Sigma p_i x_i - \lambda | F(x_1, \ldots, x_{n-1}, x_n) - y | \qquad (6)$$

By equating the partial deritatives of Θ with respect to λ and x_i to zero we get the minimum conditions

$$p_i = \lambda \partial F(x_1, \ldots, x_n)/\partial x_i \qquad \forall \ i \qquad (7)$$

$$F(x_1, \ldots, x_n) - y \equiv 0 \qquad (8)$$

This is a system of $n+1$ simultaneous equations in $n+1$ unknowns x_i and λ. Now this is a general model which, only by arbitrarily fixing y, is capable of dealing with the special case of constant returns to scale. It is made so by the absence of any assumptions regarding returns to scale. We will see later in our study of output determination that the assumption of arbitrary fixing of y will be important. Still, we have to deal with another question. This arises because in this perfect neoclassical world, where all markets are perfect, optimal factor proportions would be the same for all production units. Suppose for example (Bliss and Stern, 1982, p.168) that output y is a function of land H and X where X is a vector of all other inputs. We can write then

$$y = F(H,X) \qquad (9)$$

If we assume that F is the same for all production units and that there are constant returns to scale, cost minimization under certainty would imply that the ratio of input x_i to land, x_i/H, would be the same for all production units. Output would be proportional to land cultivated and a regression of the logarithm of y against the logarithm of H would yield a coefficient of one. The same result would be obtained by regressing the logarithm of output on that of any single factor and there would be no reason to include more than one factor in the regression equation since we should have perfect multi-collinearity. This therefore means we should encounter another obstacle when attempting to estimate a production function. This could be seen in the light of the above outlined models when we look at the marginal productivity conditions (3) with (1) which implies that the production function in (1) would be unidentified because

by our assumption of perfect markets the prices in product and in factor markets are the same for each firm and hence there would be no exogenous variables but just constants (Wallis, 1973). Thus the production function will not be identified because we would observe only one point and this would be consistent with any production function which passed through that point. A number of solutions were suggested. The simplest possibility is to introduce a time dimension where the production function had only one observation for each time period. Another possibility is to abandon the assumption of perfect markets and allow some variation in prices with for example some prices becoming endogenous variables in an imperfectly competitive market. It should also be remembered that we already assumed that output y is a predetermined variable; within this assumption a solution in the nature of these two suggestions was adopted by Nerlove (1963) in his cross-section study of public utility enterprise. In Sections 5.4 and 5.5 we show some basic characteristics relating to the markets in the villages we are studying which could help us overcome this problem.

We turn now to the specific functional form of the production function which we would like to adopt for the econometric analysis of output determination. The form which we will use for this purpose is the power function

$$y_j = e^{\alpha_o} \Pi x_{ij}^{\alpha_i} \qquad (10)$$

where y is output value and x_i's are the variable resources and where i refers to the number of explanatory variables we are going to have and j's are the number of observations. In practice (10) is assumed to have a multiplicative error u_j

$$y_j = e^{\alpha_o} \Pi x_{ij}^{\alpha_i} e^{u_j} \qquad (11)$$

which has a zero mean, a uniform variance and where successive values of the random variable u_j are independent (absence of autocorrelation in u_j). Equation (11) can be transferred to a linear form by taking the logarithm of both sides, which yields

$$\ln y_j = \alpha_o + \Sigma_i \alpha_i \ln x_{ij} + u_j \qquad (12)$$

The power function was first used by Cobb and Douglas (1928), its originators, who applied it to data for American manufacturing industry over the period 1899-1922. Since then it has been widely used. The parameter α_i is a constant which measures the elasticity of output with respect to the variable resource x_i. Under competitive conditions α_i also reflects the factors relative share in the total output. The intercept α_o can be interpreted as a measure of the technical efficiency of the individual production unit (Hoch, 1955, 1962; Mundlak 1961). Technical efficiency could reflect many attributes of the production unit e.g. knowledge, skill, location or technology.

The sum of the exponents α_i's indicate the nature of returns to scale provided that all the related inputs are included in (12). Thus, there would be increasing, constant or decreasing returns to scale according as $\Sigma_i \alpha_i \gtreqless 1$.

When some variables which should be included in the estimated equation had been excluded, the consequences of this is to give us estimates of the parameters of the variables that are included i.e.

a_i's, which are a weighted sum of all the parameters in the true specification. In this manner our estimates should be biased upward or downward depending on whether there is a positive or negative correlation between the excluded variables and the included ones (Griliches, 1957).

The Cobb-Douglas function also implies that factors are limitational in that output would be zero if any of the variable resources is zero. The isoquant of this function are asympotatic to the input axes. They are also homothetic which means that the output expansion path for fixed prices is linear emanating from the origin (Heady and Dillon, 1961).

5.3 The Variables

5.3.1 Measurement and Valuation of Output

We turn now to the variables that are going to be used in the analysis of output produced by the household. An important aspect which relates to these variables is their collection and measurement. We start with the household's produced output. As mentioned earlier (Chapter 2) most farmers in the villages grow dura which is the staple food crop. Few farmers cultivated millet or both millet and dura. In our sample 139 households grow dura, three grow millet only and seven grow both millet and dura. Beside dura and millet the other farm product is okra. The amount of crop production by the farmer was obtained by interviewing the head of the household. The amount of output of dura and millet is usually measured in Ardab. That of okra is measured in sacks. The capacity of a sack is usually between 6.5 to 7.5 keilas.

Valuation of dura and millet presented no problems. These were valued at the prevailing market's prices at the time of harvest and therefore when main sales took place. These prices represented the modal prices which were reported in the questionaire. These prices were checked against the market prices which prevailed in the main market where the villagers come and market their commodities. The prices for dura and millet are shown in Table 5.1.

Table 5.1 : Prices of dura and millet in the villages

Product \ Village	Tamari	Umshaniq	Wad-el-Kashif	Meallyab	Tebeib
Sorghum	30	30	35	35	40
Millet	40	40	40	40	40

(1) Sorghum and Millet are measured in Ardab.
(2) Values are in Pounds

We observe from Table 5.1 that the highest market price for dura prevailed in Tebeib. This can be attributed to the high population density in the village which meant that the demand for the main staple food crop is higher compared with a relatively scarce supply ofoutput produced by the village's land.

For okra the values which were reported for the sacks of okra picked up by the household were taken as the right values. The value of a sack of okra varied between one household and another which is due to the fact that the value depends on how much okra a sack was taking. Therefore in order to arrive at the total value of okra picked the weight of a sack of okra was not standardized to arrive at value by

multiplying weight by average price but gross value reported are taken. However from the number of sacks picked and the average price prevailing in the villages we could gain a rough check for any error in total value reported. The average price of a keila of okra for the villages was three pounds.

In addition to these main crops which are yielded by operating a given area of land, there is the by-product of the main crops, sorghum and millet straw. This is used for animal fodder and there is a market for it, though the majority prefers to keep it for animal use.

Our measure of output value would therefore be the composed value of the above mentioned crops, that is

$$\text{FVAL} = \text{DVAL} + \text{MVAL} + \text{KVAL} + \text{FVAL} \qquad (13)$$

where the variables have the following meaning

FVAL = Total output Value
DVAL = The Value of Dura
MVAL = The Value of Millet
KVAL = The Value of Okra
FVAL = The Value of crops by-product

5.3.2. The explanatory Variables

In this section we specify the variables which determine the output value, FVAL, described above. These are the variable resources or the x_1's of the model of production of Section 5.2.

The first of these is land area cultivated by the household.

This is measured in feddans. However we have one snag here and that is the absence of information on land quality. It might be thought that some index might be used to correct for land quality, as for example the land taxation. Though we have information on the tax imposed on the crop produced we preferred not to use this. For one thing there are a number of households who have not reported any tax because at the time the interviewing was taking place they were still not asked to pay their due amount. On the other hand, we think that these taxes do not reflect the quality of land or its productivity. They were imposed arbitrarily and depend to a great extent on the influence which the household can exert on the "committee" - composed mainly of the village head and the Village Council's members - which make the assessment. We decided therefore to use land cultivated measured in feddans uncorrected for quality.

The second explanatory variable in the determination of output will be labour. Labour is going to be measured in man hours. Thus while our measure of labour is in flow terms, some arguments might still be evoked against using such a measure if one was interested in working with a production function which is more of a technological type. As argued in Bliss and Stern (1982, p.169), the appropriate measure in this case would be the number of tasks performed, like the number of ploughings or weeding the field. We have not attempted to get any information on the number of tasks carried out. However we have data on the number of persons in each agricultural operation and the average number of hours worked per day together with the number of days worked. Male and female labour is weighted equally and child labour is weighted at half adult labour. From this we get the total hours worked during the agricultural year.

Another variable resource in the production function which we will estimate is the total hours of machine services. Machines are hired for a specified amount of money per feddan ploughed or per sack of threshed output. As was mentioned earlier the price of machine hire would seem to be determined in a monopolistic way. The data which we have shows that there is variation in cost of machine hire around the market (modal) price for each village. In fact machine hire involves bargaining and individual arrangements. All this implies that the market for this factor is far from perfect.

These are the three main variable inputs we will be using as independent variables in the estimation of a production function. In measuring these variables we have been attempting to come closer to the idea of a technological production function of the type we discussed at the beginning of this chapter.

Of course there are other variables which should be significant in the determination of the total crop produced but which are difficult to measure. Important among these is the quantity of water a field gets. It is difficult to measure this variable in an area of rainfed cultivation. The best we can do is to assume that all fields got their required amount of water. This in fact has been ascertained by the people in the villages who thought that the rainfall has been even across the villages. However differences might still persist. For example some fields location might be such that they can get more water than others. Or the story of a farmer whose crop plant faded and produced a poor crop due to lack of water during the late days of growth because of late sowing of seeds. This latter case relates to management abilities and experience. This is also difficult to

quantify.

Another variable which seems to be missing from the list of explanatory variables is fertilizers. Fertilizers are not used in these villages. One reason for this seems to be that under communal ownership of land in the area we are studying, soil fertility used to be preserved through the practice of shifting cultivation (Awad, 1971). Nowadays soil fertility is still preserved by leaving part of the land owned fallow in one year to cultivate in the next. The regrowth of forest vegetation during the period the land was left fallow helped to restore fertility, humus and organic content and protect the land from erosion. However one should not expect this system of field rotation to be working at the present as efficiently as it did in the past. For one reason, with permanent settlement of people who previously had been moving in vast areas of land, and with population pressure, the number of years a piece of land can be left fallow will be shortened. In fact tenants and those who own only a small plot of land are likely to be precluded from the benefit which the system of field rotation offers. The presence of tractors which facilitates large scale cultivation might even encourage large land owners to cultivate all land available to them. Later we will see that the availability of tractors encourages farmers to increase their cultivated plots.

There remains the question of those unquantifiable factors that affect the productivity in one way or another. We have seen how the farm location can be beneficial sometimes. It has also been mentioned that it makes a difference whether the farmer is an owner or tenant or both.[2/] In Section 5.2 we have seen how the effect of location, inter alia, could be captured by the constant term in Cobb-Douglas function

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2/ See Junankar (1976) for a test of the effect of land tenure on agricultural productivity in Indian agriculture.

for cases where it is possible to estimate for each location. In order to test for the effect of tenancy on productivity we are going to use two dummy variables D_1 and D_2. D_1 takes the value of the ratio of land owned to land cultivated if this ratio is less than one and one otherwise. D_2 takes the value of this ratio if it is greater than one and one otherwise. We expect to see a positive coefficient attached to D_1 if tenancy is inversely related to productivity. On the other hand if a high D_2 indicates inability to cultivate because of old age, or loss of interest in agriculture we expect the coefficient attached to it to be negative. In Section 5.4 we would also show how other dummy variables could be used to capture the effect of other non-measurable inputs, e.g. managerial skill.

5.3.3 The Specification

We are going to estimate a number of relations using Ordinary Least Squares method (OLS). Using the form specified in equation (20) these relations can be written as follows

$$\ln(PVAL) = \alpha_o + \alpha_1 \ln(CULT) + u_j \qquad (R.1)$$

$$\ln(PVAL) = \alpha_o + \alpha_1 \ln(CULT) + \alpha_2 \ln(HLAB) + \alpha_3 \ln(HMACH) + \alpha_4 \ln(D_1) + \alpha_5 \ln(D_2) + u_j \qquad (R.2)$$

where ln preceding a variable name denotes logarithm to the base e and the variables have the following meanings:

PVAL = Value of gross output
CULT = Land cultivated
HLAB = Total hours of labour
HMACH = Total hours of machine service
D_1, D_2 = Explained in Section 5.3.2
u_j = Error term

R.1 and R.2 are two specifications for a production function for the villages we are studying. In R.1 only one variable resource appears as a determining factor of total output. This specification will be the basis for our study of the relationship between size of farm and productivity. The magnitude of the estimated coefficient attached to the logarithm of cultivated land, α_1, would indicate the direction output per feddan changes when the area sown increases (decreases). In accordance with this specification output per feddan would increase (decrease), remain constant, or decrease (increase) with increases (decreases) in land cultivated if $\alpha_1 \gtreqless 1$.

The assumption of profit maximization as has been shown in 5.2 implies that the inputs which appear on the right-hand-side of R.2 are determined jointly with the production relation in R.2. This means that the error term u_j and the independent variables are dependent and hence single equation estimation using OLS will yield biased and inconsistent estimates of the production elasticities in R.2 (Nowshirvani, 1967). We assume here that u_j is distributed independently of the levels of land, labour and machine use. One justification for this is to take u_j as a measure of the influence of unanticipated weather fluctuations and to assume that area cultivated, labour and machine use are independent of the particular realization of u_j. This is equivalent to assuming that farmers maximize anticipated profit with respect to inputs (Hoch, 1962). However this assumption might not

be wholly true because some decisions are usually taken after the weather uncertainty is over, e.g. harvesting labour. An alternative approach (Zellner, Kamenta and Dreze, 1966) shows that given the lag between input decisions and output that occur in agriculture, OLS will give unbiased estimates of the production function.

As has been shown earlier FVAL is taken as the value of total crop production in the farm. Its use as the dependent variable in estimation of production function from cross-section farm data assumes implicitly that the crop composition of total production is similar for different farms. This as has been argued by Bardhan (1973) is a serious assumption which has important consequences for the estimated function. One such consequence is that if some sizes of farm tend to grow more high-valued crops, what is essentially a crop-composition effect may be interpreted in production studies as size effect or returns to scale effect in production. For our sample we think that this problem would hardly arise because as shown earlier a very small percentage of farmers grow more than one crop (dura and millet), namely, 4.7% and that the majority grow only sorghum, 93.3%. Therefore even if this problem of composition effect is at all real it would not bias our estimated coefficients in any way.

5.4 The Regression Results

5.4.1 Size of Farm and Productivity

The estimated coefficients of R.1 were obtained for each one of the five villages separately and for all the villages together. These are shown in Table 5.2. All slope coefficients, a_1, in the

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5.4 The Regression Results

5.4.1 Size of Farm and Productivity

The estimated coefficients of R.1 were obtained for each one of the five villages separately and for all the villages together. These are shown in Table 5.2. All slope coefficients, a_1, in the

villages are significant at 5% level of significance and they show that output is positively correlated with the size of land cultivated. The regression for all the villages (last row of Table 5.2) indicate that amount of land cultivated explains 42% of the variance in output. The values of a_1 imply that output per feddan seems to be positively related to the size of operated holdings in four out of five villages, i.e. $a_1 > 1$. The results for Tebeib show that output per feddan is inversely related to the size of farm, i.e. $a_1 < 1$. However as the t-test shows a_1 is not significantly different from unity for three out of five villages. In other words one lies inside the 95% confidence interval for a_1. A significantly positive relationship between size of farm and output per feddan exists for Wad-el-Kashif and Meallyab.

The first thing to note about these results is the finding that output per feddan is roughly proportional to land cultivated in three out of five villages. This is unlike some of the results obtained for India where output per acreage is found to be inversely related to the size of operated holdings (Sen, 1962; Saini , 1971). The second thing is the increasing relationship for the other two villages, Wad-el-Kashif and Meallyab. We will try to give some explanations which could throw some light at these two results.

This concerns the use of modern technology (machine services) in these two subsets of our sample. For, though tractor cultivation is present in all the villages, households in these two subgroups differed in their utilization of machine services. In particular in the first subset (Tamari,Tebeib and Umshaniq), some farmers used the tractor to plough only part of their land while using the

Table 5.2 : Regression Results, e quation R.1: Dependent Variable ln (PVAL)

Village	No. of observations	α_o	α_1	$t^* = \frac{\alpha_1 - 1}{SE(\alpha_1)}$	R^2	Adjusted R^2	F	S.E.
Tamari	49	7.34	1.033 (.245)	0.135*	0.27	0.26	17.78	1.029
Umsha iq	18	7.32	1.117 (.274)	.426*	.51	.48	16.54	.739
Tebeib	32	8.71	.682 (.218)	1.456*	.24	.22	9.75	.767
Wad-el-Kashif	40	5.81	1.848 (.341)	2.488	.43	.42	29.42	2.018
Meallyab	13	3.05	2.689 (.491)	3.439	.73	.71	29.99	1.558
All Villages	152	6.29	1.55 (.15)	3.653	.42	.41	106.21	1.406

Notes (1) A formal test of the hypothesis $H_o : |\alpha_1| = 1$ against $H_1 : |\alpha_1| \neq 1$ is provided by looking at the calculated t value, t^*, against the tabulated t at 5 % level of significance. If $t^* < t$ the null hypothesis H_o cannot be rejected, i.e. α_1 is not significantly different from unity.

(2) Starred values of t are less than $t_{.05}$.

(3) Figures in parentheses are the standard error of the estimated coefficient α_1.

traditional methods of cultivation (the axe, hoe and digging stick) in the remaining part. Thus the mix of factors differ between this group and the group of households in Wad-el-Kashif and Meallyab. In fact tractor cultivation is dominant in Wad-el-Kashif, a thing which may be due to the presence of a tractor owner in the village. It is also obvious that large pieces of land could be brought under ploughing when the tractor was used. The use of the tractor could also offer some economies of scale, e.g. relatively deep ploughing of the soil, a thing which requires large and strenuous efforts to achieve using the traditional tools of cultivation, and hence exploitation of the deep layers of soil which are still rich in organic content. The latter advantage is of course relevant only in the short run and in these villages where the tractor use is only recent. This is so because tractor cultivation for long periods of time and without the use of fertilizers and rotation has been observed to lead to soil erosion (O'Brien, 1978). The other advantage which could result from use of tractors is that it could lead to a high degree of specialization where labour effort is released for use in tasks which could enhance productivity e.g. better weeding. On the other hand the first sub group (Tamari, Tebeib and Umshaniq) which combined both traditional and modern techniques should get the benefits not only of modern techniques but also in obtaining the okra crop by virtue of their confining ploughing to only part of their cultivated plots. In other words, the first sub group of our sample appears to be superior in the managerial skills, that is, the ability to make use of both modern and inherited means of cultivation and to mix these in an optimal way. This in fact is confirmed by the larger magnitude of the intercepts for Tamari, Tebeib and Umshaniq compared to that for Wad-e-Kashif and Meallyab.

The cost of machine, total family mandays and total hired mandays per feddan of cultivated land for different size of farms is presented in Tables 5.3, 5.4, 5.5, 5.6 and 5.7 for Tamari, Tebeib, Umsha:iq, Wad-el-Kashif and Meallyab respectively.

Table 5.3 : Labour and Machine Cost per feddan of Cultivated Land in Tamari

Area	No. of Farms	Hired Mandays	Family Mandays	Total Mandays	Machine Cost (in L.S.)
≤ 5.5	11	0.08	15.1	15.2	0.00
5.5-10.5	19	5.34	9.08	14.43	.67
10-15.5	12	4.08	12.24	16.32	.54
15.5-20.5	3	.00	12.04	12.04	.00
20.5-30.5	2	2.43	2.58	5.04	2.40
30.5-40.5	1	.04	8.48	8.53	2.41
40.5-50.5	1	2.58	2.88	5.47	3.60

Table 5.4 : Labour and Machine Cost per feddan of cultivated Land in Tebeib

Area	No. of Farms	Hired Mandays	Family Mandays	Total Mandays	Machine Cost (in L.S)
≤5.5	4	1.8	8.4	10.2	1.15
5.5-10.5	13	1.3	6.51	7.81	1.75
10.5-15.5	2	.18	11.89	12.07	3.17
15.5-20.5	7	2.76	1.75	4.51	2.17
20.5-30.5	3	3.32	2.9	6.22	1.63
30.5-40.5	1	3.25	0.86	4.11	3.0
40.5-50.5	2	2.74	0.61	3.35	2.88

Table 5.5 : Labour and Machine Cost per feddan of Cultivated Land in Umshaniq

Area	No. of Farms	Hired Mandays	Family Mandays	Total Mandays	Machine Cost (in L.S)
≤5.5	1	0.6	4.2	4.8	1.6
5.5-10.5	5	1.8	6.79	8.59	2.8
10.5-15.5	4	.9	2.6	3.50	3.6
15.5-20.5	4	5.93	1.71	7.64	3.3
20.5-30.5	2	1.62	.00	1.62	3.7
30.5-40.5	1	1.24	2.48	3.72	1.5
+50.5	1	3.05	.00	3.05	2.35

Table 5.6 : Labour and Machine Cost per feddan of Cultivated Land in Wad-el-Kashif

Area	No. of Farms	Hired Mandays	Family Mandays	Total Mandays	Machine Cost (in L.S.)
≤5.5	10	1.28	8.5	9.78	3.22
5.5-10.5	14	1.66	8.13	9.79	2.25
10.5-15.5	2	2.86	.00	2.86	.00
15.5-20.5	6	.8	8.22	9.02	2.40
20.5-30.5	3	11.7	1.45	13.5	4.1
30.5-40.5	2	2.61	.66	3.27	7.2
40.05-50.5	2	.9	1.5	2.40	6.2

Table 5.7 : Labour and Machine Cost per feddan of Cultivated Land in Meallyab

Area	No.of Farms	Hired Mandays	Family Mandays	Total Mandays	Machine Cost (in £'s)
≤ 5.5	2	0.8	1.6	2.4	2.00
5.5-10.5	5	1.44	5.56	7.0	.83
10.5-15.5	3	.58	8.8	9.38	.00
30.5-40.5	2	.86	2.67	3.53	1.60

Tables 5.3 to 5.7 indicate that, generally, an increase in machine service is accompanied by a reduction in application of labour. One benefit of using the machine as we have said is that by reducing the number of days required to plough and turn the land mannually it enabled an increase in labour productivity and therefore an increase in yields. Secondly, more family labour is used in small farms than in large ones and that as size of farms increases family labour becomes less and is complemented by hired labour and machine services. Tamari seems to be much more dependent on labour intensive methods than the other villages though more capital services are used in farms of twenty feddans or over than smaller ones. The figures for Tebeib, for which productivity per feddan apparently falls with size of farm, show that amounts of hired labour rise as size of farm increases and it constitutes a large per cent of total labour used. More capital service is used too as farm size increases. Thus one can say that in this village smallfarms applied more family labour to a feddan of land than large ones and hence get more output per feddan of land than large ones. Compared to Tebeib the intensity of machine use in Wad-el-Kashif is higher for all size classes of cultivated land except in farms size 10.5-15.5. The figures for Meallyab in Table 5.7 show that farms

which used no or small amount of capital services used large amount of family labour and that the amount of hired labour in the village is a a small per cent of total labour used.

In order to take account of the difference in the values of the intercept term α_o and slope coefficient α_1 between the two groups of villages referred to above we estimated the following relationship for all the observations

$$\ln(FVAL) = \alpha_o + \alpha_1 \ln(CULT) + \alpha'_o T_1 + \alpha'_1 T_1 \ln(CULT) + u_j \quad (R.1.1.)$$

where

T_1 = 1 for observations that come from Tamari, Umshaniq and Tebeib
0 for observations from Wad-el-Kashif or Meallyab.

The intercept term for the group where $T_1 = 1$ will then be $\alpha_o + \alpha'_o$ and the slope coefficient is $\alpha_1 + \alpha'_1$. For the group where $T_1 = 0$, the intercept is given by α_o and slope by α'_1. The results of regression R.1.1 are shown in Table 5.8.

The results in Table 5.8 show that both the coefficient on the intercept dummy T_1 and on $T_1 \ln(CULT)$ which represents the shift in slope coefficient are significantly different from zero. Moreover the coefficient on the intercept dummy is positive. This means that Tamari, Tebeib and Umshaniq are technically more efficient than Wad-el-Kashif and Meallyab. Note however that when $T_1 = 1$, the slope coefficient is given by 2.03-1.01 which is equal to 1.02 and is so close to unity which means that output per feddan remains constant as size

Table 5.8 : Regression Result, equation R.1.1 : Dependent Variable ln(PVAL)

Variable	Coefficient
constant	5.18
T_1	2.40 (10.79)
ln(CULT)	2.03 (100.5)
T_1ln(CULT)	-1.01 (11.82)
R^2	.46
Adjusted R^2	.45
S.E.	1.36
F	41.66
N	152

Notes: (1) Figures in parentheses are the F value of the estimated coefficients; $t = \sqrt{F}$.

(2) S.E. is the standard error of the estimated equation

(3) N is the number of observations used in regression

of farm increases for the group of farms where T_1 takes the value of unity.

We turn now to the results of equation (R.2) which includes the three explanatory variables : labour hours, hired machine hours and land plus the dummies D_1 and D_2. The estimated coefficients on these variables are shown in Table 5.9. The table shows also the result for a regression which does not include D_1 and D_2 (last column).

Table 5.9 : Regression Result, equation R.2 : Dependent Variable ln(PVAL)

Variable	Coefficient	Coefficient
Constant	4.43	4.42
ln(CULT)	0.50 (6.95)	0.52 (7.89)
ln(HLAB)	.62 (52.10)	.58 (44.75)
ln(HMACH)	.56 (20.10)	.57 (21.02)
$\ln(D_1)$	-.17 (0.44)	-
$\ln(D_2)$	.37 (1.04)	-
R^2	.59	.58
Adjusted R^2	.57	.57
S.E	1.19	1.19
F	41.34	52.41
D.W.	1.59	1.89
N	152	152

Notes: (1) Figures in Parentheses are the F values of the estimated coefficients (see also notes to Table 5.8).

(2) D.W. is Durbin-Watson statistics and is obtained after ordering observation in an ascending order by size of farm as measured by cultivated land.

As Table 5.9 indicates the estimated elasticities for the three main factors, land cultivated (CULT), labour (HLAB) and machine service (HMACH) are significantly different from zero at 5% level of significance. The variables D_1 and D_2 which we included to test for the effect of tenancy are not significant as explanatory factors of the variation in output. The three significant inputs explain 59% of the total variation of output as shown by R^2.

5.4.2 Productivity of inputs and prices

In this subsection we look at the computed value marginal

productivities which are estimated using the results in Table 5.9. We will also give a comparison of the value marginal productivity and prices. We have seen in 5.2 that if firms or production units behave competitively in both input and output markets, where there is no uncertainty and that they maximize the difference between the value of output and the costs of inputs, then the value of marginal product of an input will be equal to its price. When this occurs a firm is said to be efficient in allocating inputs in the production process. However, the practice of drawing inferences about allocative efficiency using the tools of production function has been criticized on many grounds (see for example Schultz, 1964). One problem as we have mentioned earlier is the suspicion that output elasticities which one gets by estimating a production function might be biased estimates of the true parameters. It has also been argued that production function studies of agriculture do not distinguish between the different responses of output to labour used in different seasons of the agricultural year (Nath, 1974). We will incorporate this notion in our analysis later. It will also be argued that some of the results which we shall obtain might be interpreted better in the light of models that introduce the elements of risk and uncertainty in the maximization process of farmers.

The estimated marginal productivities are shown in Table 5.10. The table shows also the mean input price of each factor.

From Table 5.10 we can see that the marginal productivity of labour is less than the average wage rate for hired-in labour and is almost half the wage rate. This, then, represents an evidence of allocative inefficiency. There is one thing which should be mentioned

Table 5.10 Value Marginal product and Mean input prices

Factor	Value Marginal product	Mean input price
Land	8.99	1.14
Labour	0.21	0.41
Machine Service	62.7	15.95

Notes: (1) The value marginal products are estimated at the geometric mean values of inputs. If α_i is the output elasticity of factor x_i, the value marginal product $(\partial y/\partial x_i)$ is obtained as follows: $\partial y/ x_i = \alpha_i \bar{y}/\bar{x}_i$.

(2) Marginal value products are expressed in the following dimension : Land in pounds per feddan; labour in pounds per hour and machine service in pounds per hour.

anyway and this concerns the use of the sample's average wage rate as the opportunity cost of labour. This average might be biased towards the busy season's high wage rate when demand for labour is at its peak. This suggests that the appropriate opportunity cost in this case should be a weighted average of the average wage rate for the slack and busy seasons, the weights being the proportions of man hours used in the two seasons. Alternatively one may compare the average wage rate with the marginal product of labour in that season. The regression results which incorporate this aspect of agricultural seasonality are going to be discussed below.

The other striking feature of the results in Table 5.10 is the high value of rent of land computed. Rent of land for our sample lies between 0.60 and 2.0 pounds per feddan and the average opportunity cost

is 1.14 as it appears in Table 5.10. The value marginal product of a feddan of land of almost 9 pounds, as it appears in Table 5.10, is high compared with a rent for a feddan of land of 1.14 pound. We should, however, remember that "... rent is in large part a return to capital that has been embedded in such land" and that "... it is important to distinguish between the original natural endowment and the capital embedded in it. In many long settled communities much has been invested over generations in levelling the land so that water can be applied, in sinking wells to provide water, in making ditches to distribute the water, and in drainage to check soil salinity." (Schultz, 1964, pp. 98-99).

Thirdly we note that machine service is characterized by a high marginal productivity compared with its price. Under the assumption of declining marginal productivity of factors in production, a high marginal productivity of a factor compared with its price would imply that the application of the input in production falls short of the quantity which brings marginal productivity to equality with price.

Perhaps the result concerning the utilization of tractors in production should be considered a bit further. This is so because some features associated with tractor use and markets may have some implications which could help us understand why marginal productivity exceeds price or for that matter why farmers do not utilize such a technical innovation fully in production. Firstly we should note that the use of tractors for ploughing and sowing must occur some time before the output appears and to such an extent farmers should consider the uncertain outcomes associated with decisions to use the tractor instead of cultivating by traditional methods. Another element of

risk associated with tractor use is its adverse effect on the traditional okra crop. We have also seen in Section 3.4 that the cost of tractor hire for ploughing and sowing could represent a large share of the expected value of output. For some cases the share of tractor cost might range between 18% and 20% of the average output value. Owners of small plots of land and landless cultivators might find it difficult to finance the cost of tractor hire. Credit facilities are rare and the only form of credit involves mortgage of the crop of the farmers. Poor farmers also lack the sources of wealth (land, animals) which could avail them in the event of a bad crop. Under such circumstances the propensity to take risks and uncertainty which the use of the tractor involve may be low. With a high degree of risk averseness if farmers are maximizing the expected utility of the net value of farm products then an optimum may be attained in which the value of marginal product of inputs used in production exceeds prices, i.e. $\frac{\partial F}{\partial x_i} = F_i = \theta P_i$, with $\theta > 1$ (see Bliss and Stern, 1982, pp.286-290).

A more reasonable estimate of marginal productivities are obtained when account is taken of the differences that exist between the two groups of our farms, i.e. when dummy variables are introduced. Table 5.11 shows the results of this regression when the equation took the following form:

$$\ln(PVAL) = \alpha_o + \alpha_1 \ln(CULT) + \alpha_2 \ln(HLAB) + \alpha_3 \ln(HMACH) + \alpha'_o T_1 + \alpha'_1 T_1 \ln(CULT) + \alpha'_2 T_1 \ln(HLAB) + \alpha'_3 T_1 \ln(HMACH) + u_j \quad (R.3)$$

where the variables as defined previously. T_1 takes the value of 1 for observations from Tamari, Tebeib and Umshaniq and 0 for observations from Wad-el-Kashif and Meallyab.

Table 5.11 : Regression Results, equation R.3 : Dependent Variable ln(PVAL)

Variable	Coefficient
Constant	3.81
T_1	2.71 (6.53)
ln(CULT)	0.69 (7.55)
ln(HLAB)	.64 (36.65)
ln(HMACH)	.69 (21.82)
T_1 ln(CULT)	-.016 (.002)
T_1 ln(HLAB)	-.37 (3.57)
T_1 ln(HMACH)	-.45 (2.47)
R^2	.61
Adjusted R^2	.59
S.E.	1.17
F	32.3
D.W.	1.64
N	152

Notes: (1) Figures in parentheses are the F value of estimated coefficients.

(2) See notes to Table 5.8 and 5.9.

As Table 5.11 shows all coefficients are significantly different from zero at 5% level of significance for the sample of villages, but none of the coefficients of the dummy are significantly different from zero at 5% level of significance. The marginal productivities estimated using the results in Table 5.11 are shown in Table 5.12.

Table 5.12 : Value Marginal Product estimated using Regression R.3.

Factor	Value Marginal Product
Land	3.64
Labour	0.06
Machine Service	22.65

Note : see notes to Table 5.10

The figures in Table 5.12 show that except for labour the difference between marginal product and opportunity cost of other input (shown in Table 5.10) is not as large as it appeared previously. As we mentioned in Section 3.4, in Umshaniq the market (modal) price of machine service was twenty pounds per feddan and in Tamari the rent per feddan of land reached two pounds. However, given that cultivation in these villages is dominated by family operated farms which still depend on family labour and traditional methods of cultivation to a large extent the low marginal product of labour could be interpreted in terms of an intensive use of a factor (family labour) with a low opportunity cost to such an extent that its marginal productivity is driven to a low level. It is also true that when traditional methods

are used in ploughing it requires many working days with a small contribution to production, i.e. a low average productivity of labour compared with average productivity of labour in farms where machine use cuts the number of mandays to a large extent.

5.4.3 Seasonality

The suggestion that the nature of seasonality of agricultural production should be taken into account in studies of production in agriculture of developing countries is followed here. According to Nath (1974), labour in the slack and busy seasons should enter as separate arguments in the estimation of production function. Moreover one should expect to find a higher marginal product associated with labour in the busy season than in the slack one.

The information which we obtained for our sample allows us to perform such an exercise. In the questionaire farmers were asked to report days spent in the different agricultural operations throughout the year and hours worked. Thus we had a breakdown of operations into ploughing, sowing, weeding, harvesting and threshing. We took the total number of hours spent on the first three operations to represent the slack season's labour while labour spent on the last two to represent the busy season labour. This is a reasonable assumption to make because with the introduction of the tractor the demand for labour, particularly for the most demanding of the first three operations, viz, ploughing and sowing, has been reduced greatly in the area. This is also reflected in the variation of the wage bill across the agricultural year. With seasonality the regression equation

looks as follows

$$\text{Ln (PVAL)} = \alpha_o + \alpha_1 \ln(\text{CULT}) + \alpha_2 \ln(\text{HBLAB}) + \alpha_3 \ln(\text{HSLAB}) + \alpha_4 \ln(\text{HMACH}) + u_j \qquad \text{(R.4)}$$

where HBLAB : hours of labour in busy season
HSLAB : hours of labour in slack season

and the other variables as defined before. The results of regression (R.4) are shown in Table 5.13.

Table 5.13 : Regression Results; equation R.4 : Dependent Variable ln(PVAL)

Variable	Coefficient
Constant	3.95
ln(CULT)	0.29 (2.59)
ln(HBLAB)	0.69 (46.67)
ln(HSLAB)	.23 (9.04)
ln(HMACH)	.61 (27.77)
R^2	.64
Adjusted R^2	.63
S.E.	1.11
F	66.3
D.W.	1.93
N	152

Notes: (1) Figures in Parentheses are the F value of estimated coefficients.

(2) See notes to Table 5.8 and 5.9

All the estimated coefficients in Table 5.13 are significantly different from zero at 5% level of significance. The explanatory power of the model also increased with the distinction between labour in the slack and busy season. As we expected a higher coefficient is attached to busy season labour than the one on slack season labour. The estimated marginal productivities using the elasticities in Table 5.13 are shown in Table 5.14 together with the mean input prices.

Table 5.14 : Value Marginal Product estimated using Regression R.4.

Factor	Value Marginal Product	Mean Input Price
Land	5.8	1.14
Busy season Labour	0.8	0.45
Slack season Labour	0.16	0.39
Machine service	77.3	15.95

Notes: (1) for definition of busy and slack labour see 5.4.3.
(2) see Notes to Table 5.10.

From Table 5.14 it is clear that not only is labour in busy season more productive but also that the value of marginal product is higher than the wage rate, namely, 1.77 of the wage rate. Ideally, however, one might like to compare the value marginal product of labour in that season with a wage rate for the busy season labour and not with the average wage rate for the season. The average wage rate may underestimate the market wage for busy season; hence the excess of marginal product over wage rate.

5.4.4 Returns to scale

We said in 5.2 that the sum of the exponents on factors in a Cobb-Douglas production function indicates the degree of returns to scale in production. From Table 5.9 for the regression where only three explanatory factors appear the sum of estimated coefficients is equal to 1.67. This suggests that over the sample the farms in the villages experienced increasing returns to scale. One test to examine the statistical reliability of this outcome is to compute the statistics

$$F^* = \frac{\Sigma\hat{u}_2^2 - \Sigma\hat{u}_1^2}{\Sigma\hat{u}_1^2} \qquad (14)$$

where $\Sigma\hat{u}_2^2$ = sum of squared residuals where the exponents in the Cobb-Douglas are restricted to unity

$\Sigma\hat{u}_1^2$ = sum of squared residuals from the unrestricted function

The statistics in (14) have an F distribution with $(1,N-K)$ degrees of freedom, where N is the total number of observations and K is the number of estimated coefficients. The observed value of F^* is then compared with the theoretical value of $F_{0.05}$ with $(1,N-K)$ degrees of freedom. If $F^* > F_{0.05}$ the assumption of constant returns to scale will be rejected (Koutsoyiannis, 1973 , p.171). One way of restricting the parameters to unity in the Cobb-Douglas function of Table 5.9 is by regressing output per feddan on labour and machine hours per feddan. The resulting F^* statistics from our calculation was 51.49. The tabulated F value at 5% significance level and (1, 120) degrees of freedom is 3.92. We therefore accept the result that there are increasing returns to scale for the farms in our sample.

produced output is calculated for different size classes of cultivated land. These are shown in Table 5.15. The dietary needs of the family are calculated under two assumptions. One is a diet (diet A) in which the per capita requirement for sorghum amounts to four kilograms per week. Under the second assumption the family diet (diet B) is assumed to contain less of sorghum. The quantity per individual under diet B is assumed to be equal to three kilograms per week (Culwick, 1951, p.149).

As Table 5.15 reveals, under diet A, 63 (41%) of the families in our sample showed a deficit of production over consumption requirement as stipulated by nutritionists. Under diet B the number is smaller amounting to 46 or 30%. But because the families in the area depend mainly on sorghum cereals for their diet one may take the first figure as relevant at this stage. The other thing to note from Table 5.15 is that as size of land cultivated increases the number of families with a deficit in production decreases. In fact families who cultivated more than thirty feddans had a surplus of production over own consumption needs. A large per cent of families who cultivated small plots seem to produce less than what is adequate according to nutritional standards. By these standards some 55% of families who cultivated less than ten feddans show a deficit in produced output. One more thing which is revealed in Table 5.15 is that the average size of family increases as size of land cultivated increases. Thus it seems that for our sample large farms had more working individuals than small farms. As we have seen earlier in the two villages where output per feddan increases with farm size, the participation of family labour increases as farm size increases.

Table 5.15 The number of households in the sample with deficit or surplus of grain production over consumption needs

Cultivated Land	Average Family size	Diet Type A		Diet Type B	
		Households with surplus	Households with deficit	Households with surplus	Households with deficit
≤5.5	4.18 (0.40)	8	23	11	20
5.5-10.5	4.89 (.33)	31	25	37	19
10.5-15.5	5.91 (.43)	16	6	20	2
15.5-20.5	6.45 (.50)	13	7	16	4
20.5-30.5	6.10 (.95)	8	2	9	1
30.5-40.5	5.86 (.46)	7	0	7	0
40.5-50.5	7.8 (1.77)	5	0	5	0
50.5 +	8.0 (0.0)	1	0	1	0

Notes: (1) Figures in parentheses are standard errors.

(2) For diet type A it is assumed that a family composed of six persons would require 24 kilograms per person weekly. In diet type B a person's weekly requirements of dura is assumed to be 3 kilograms.

Thus availability of a food surplus for large farms as well as more working members, which induces more specialization, might be one explanation why large farms were able to produce more output per feddan than small ones.

5.6 Conclusion

In this chapter an attempt to study the efficiency of farmers has been made. This is done through the apparatus of production function. Though the use of this tool to attain this end is usually surrounded by many difficulties, both theoretical and practical, we tried to get over these through the use of a set of data the measurement and the markets in which this set is generated would have reduced the limitations of the tool of production function to some extent.

The results which are obtained show a high correlation between output value and the cultivated land. Average productivity of land seems to be proportional to size of farm for some sub group of observations and increasing for another. For the latter there is a tendency to use more capital services per feddan and to reap the advantage of a higher average productivity of mandays which specialization offers compared to the first one. Large farms also used more family labour per feddan compared to small ones for the group where average productivity of land increases with size of farm. We have also seen that over the sample the average family size is larger for large farms compared to small ones. Hence the availability of more family labour in some large farms.

As regards allocative efficiency there seems to be a misallocation of resources. The result indicates that reallocation of factors, particularly in capital services could lead to an increase in output. The quantity of capital services applied to production seems to fall short of the quantity which would lead to optimal allocation of the input. This can be attributed partly to the fact that machine services are scarce and subject to monopolistic control and partly because poor farmers might be risk averse and hence make no use of these services at all or use it in only part of cultivated land.

We have also found that agriculture is characterized by seasonality where slack season labour (includes labour used in ploughing and sowing) is marked by a low productivity compared to busy season labour. Increases in output could therefore be sought by using more machine services that could lead to substitution of slack season labour while utilizing labour thus released for other activities that can be beneficial to the community (dairy production). There remains however the question of organization and control of the market for capital services.

We have also found that more than half the families cultivating areas of land less than or equal to ten feddan produce less than what is required of the main food grains as set by the nutritional standards.

CHAPTER 6 - Tenancy

6.1 Introduction

Tenancy and the form which it takes occupies a very important place in the discussion of productivity and efficiency of farmers in rural agricultural communities. Writers since Adam Smith and Marshall have been discussing the economic efficiency of own, fixed cash rent and crop sharing cultivation. Section 6.2 deals with the theoretical under-pinnings of tenancy and offers a broad outline of the issues which evolved in the debate concerning tenancy. Section 6.3 looks at the type of tenurial arrangement in our sample, the yield and inputs intensities at different categories of farms. In Section 6.4 we test a model for the determination of tenancy which is developed by Bliss and Stern (1982), after incorporating the features which are particular to the area of our study. The conclusions are then provided in 6.5.

6.2 Theoretical Background

All classical economists believed that share cropping is inefficient. Writing about the metayage (share cropping) system in France, Adam Smith expressed the view that under share cropping a tenant would not be interested in improvement of land because half of whatever produced usually went to the landlord who put on nothing in production. Viewing the share cropping system in terms of the historical development of tenurial arrangements, he conceded that, not only did share cropping preclude investment in land but that it was even less productive when compared with a fixed rent contract, though superior to the serf-system which preceded it (Smith, 1937, Book III,

pp.361-372).

It is at the hand of Marshall that the analysis of share tenancy gained a deep and illuminating insight. Marshall, like the classical writers, believed that share cropping is inefficient:

> "When the cultivator has to give to his landlord half of the returns to each dose of capital and labour that he applies to land, it will not be to his interest to apply any dose the total return to which is less than twice enough to reward him. If then he is free to cultivate as he chooses, he will cultivate far less intensively than on the English plan, he will apply only so much capital and labour as will give him returns more than twice enough to repay himself: so that his landlord will get a smaller share even of those returns than he would have on the plan of fixed payment".
>
> (Marshall, 1956, BookVI, Chapter X, pp.535-36).

The ingredients in the above argument can be shown through the following diagrammatic presentation:

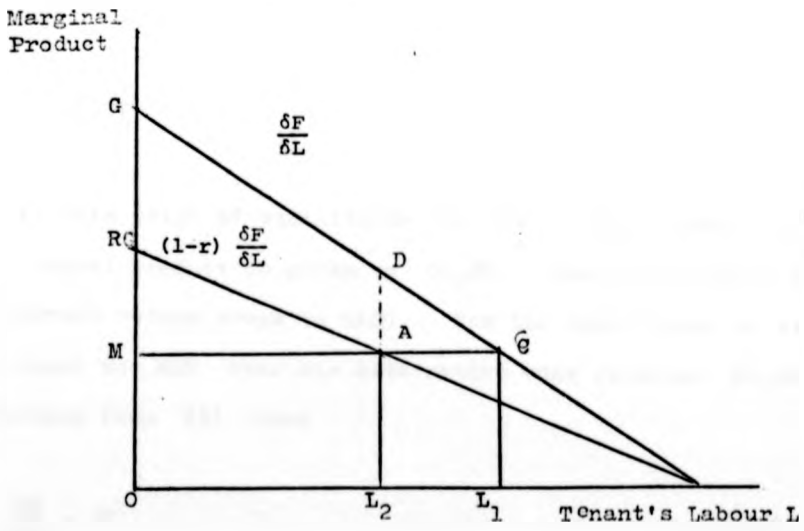

FIGURE 6.1

In the diagram tenant's labour L is measured along the horizontal axis and is assumed to be the only variable input, other inputs fixed. $\frac{\delta F}{\delta L}$ represents the marginal product of labour with given plot of land. In a perfectly competitive labour market the tenant's marginal cost is equal to the wage rate which is represented by the horizontal line MC. Under fixed rent cultivation, the tenant provides labour up to the point where his marginal product $\frac{\delta F}{\delta L}$ is equal to the wage rate. In the diagram this occurs at point L_1. Total product is given by OL_1CG. The returns to the tenant farmer equals OL_1CM, and the landlord's is MCG.

Under share cropping tenancy things are different. The share cropper will receive only $(1-r)\frac{\delta F}{\delta L}$, where r is the landlord's share in output, and accordingly $\frac{\delta F}{\delta L}$ will shift downward at every point. The share cropper equilibrium will be at point A where his marginal cost given by the market wage rate w is equated to his marginal returns, that is:

$$(1-r)\frac{\partial F}{\partial L} = w \qquad (1)$$

At this point of equilibrium the share cropper puts L_2 of labour. Total product is given by OL_2DG. The tenant gets OL_2AR. The landlord's return drops to RADG. Now the tenant gets an extra earning equal to MAR over his alternative wage earnings OL_2AM, and as is obvious from (1) that

$$\frac{\partial F}{\partial L} > w \qquad (2)$$

which means that the marginal product of tenant labour is higher than

its marginal cost. Thus unlike owner cultivators or cultivators leasing in land under fixed rent, share cropper does not apply as much labour so that labour/land ratio will be lower and production will be inefficient. In Marshall's analysis this inefficiency would not have risen had it been possible for adjustments to be made in a manner which would enable the landlord to control the amount of capital and labour supplied by the tenant and the amount of capital supplied by him. However, in his view these adjustments would not have been possible at any rate, because share cropping arrangements were based on custom rather than contract. An examination of the possible range of such adjustments was provided by Johnson (1950).

In his analysis of share tenancy Johnson sets out to consider the neglected theoretical issue "... of how the tenant determines the amount of land to rent" (Johnson, 1950, p.114) and "... the type of adjustments that landlords and tenants have made in their mutual relations to make crop-sharetenancy function reasonably well" (p.115). Johnson's model can be set as follows: consider the tenant's choice of factors of production land H and labour L. (w,p,r) are the wage rate, the price of the product and the share proportion and are given constants. Output Y is a function of land H and labour L, thus

$$Y = F(L,H) \tag{3}$$

An equation describing profit is given by

$$\Pi = pF(L,H) - wL - rpF(L,H) \tag{4}$$

The tenant maximizes profit Π with respect to L and H. Differen-

entiating with respect to L we have

$$w = P(1-r)\frac{\partial F}{\partial L} \qquad (5)$$

and with respect to H,

$$(1-r)\ p\frac{\partial F}{\partial H} = 0 \qquad (6)$$

In (5) we have again the Marshallian result of the inefficiency of share cropping. Equation (6) implies that the tenant will continue to rent additional land until the value marginal product of land is zero. Johnson (1950) recognizes the implausibility of these results, in particular the one which implies that land utilization will continue up to the point where its marginal productivity is driven to zero. Not only are they implausible, but according to Johnson, also inconsistent with the evidence, meagre though it might be, provided by data collected from crop-share rented farms in Iowa for the period 1925-46, which indicated that crop-share contract yields at least as much, if not more rent per acre than does the cash lease on comparable farms. As we have seen before, the theoretical analysis portrayed in Figure 6.1 would indicate returns to the landlord under fixed rent contract should exceed those which he gets under share-cropping contract. This apparent inconsistency of evidence with theory brought Johnson to his second task, i.e. of considering the possible techniques whereby the landlord could enforce on the tenant the desired intensity of cultivation. According to Johnson three techniques for achieving this were available to the landlord:

> "The first is to enter into a lease contract that specifies in detail what the tenant is required to do. A second is the share in payment of expenses to the same extent as in sharing of output. The third is to grant only a short term lease, which makes possible a periodic review of the performance of tenants" (p.118).

Johnson concentrates on the last technique, since he argues that the first, while common in parts of Europe, is unusual in the United States. The second technique was dismissed outright because "within the framework of crop share lease, the possibility of sharing expenses is limited in scope" (p.119). The third technique is favoured by Johnson because

> "with a short term lease renters are obviously aware that landlords have the alternative of renting their land for a cash rent independent of current output. Consequently, the tenant must plan to produce an average output per acre that will provide a rental payment, if yields are average, equal to the possible cash rent plus any additional payment required to compensate the landlord for the uncertainty that he bears" (p.120).

A contribution to the theory of share tenancy which dealt with the first technique at length was made by Cheung (1969). In his analysis of share cropping the determination of land rented by the tenant, the rental share and amount of labour are determined in a freely negotiated contract between the two concerned parties, the landlord and tenant. According to Cheung, "... each contracting party is free to accept or reject the negotiated terms of a share contract" (p.16), and "... the terms in a share contract mutually agreed upon by the landowner and the tenant will include the rental percentage and the ratio of non land to land input" (p.19). The rental percentage r and tenant's labour L are chosen in such a

manner that the landlord's total rent R from m farms is maximised subject to the constraint that the tenant share in production is at least equal to his alternative wage earnings, wL. Explicitly, the landlord solves the problem

$$\underset{(r,m,L)}{\text{Max.}} \quad R = r.m.F(L,H) \tag{6}$$

$$\text{s.t.} \quad wL \leq (1-r)F(L,H) \tag{7}$$

where $H = \frac{\bar{H}}{m}$; $\bar{H}$ is total land owned by the landlord.

This problem can be reformulated as follows: choose R, L and m to maximize

$$R \quad \text{subject to} \quad F - \frac{R}{m} \geq wL \tag{8}$$

Or assuming the constraint binds, and substituting for R,

$$\underset{m,L}{\text{Max.}} \quad m(F(L,\frac{\bar{H}}{m}) - wL) \tag{9}$$

without constraint. Differentiating with respect to L we have

$$F_L = w \tag{10}$$

and with respect to m

$$F - wL - \frac{\bar{H}}{m} F_H = 0 \qquad (11)$$

The first order conditions in (10) give wage equal to marginal product and the second, using $\frac{R}{m} = F - wL$, yields

$$\frac{R}{m} = F_H.H \qquad (12)$$

The landlord's rent per tenant is the land per tenant, H, times the marginal product of land, F_H, and we have efficiency : the wage is equal to the marginal product of labour, and the rent is equal to marginal product of land. This implies that competitive shares exhaust the output, as if we are at the point on a constant-returns-to-scale production function.

The difference between (10) and the Marshallian result in (1) comes from the assumption that for the latter r is fixed and L is chosen by the tenant independent of the landlord's view, whereas in the Cheungian analysis both r and the level of input L are stipulated by the landlord.

However, it is argued that an alternative to stipulating cultivation procedure, which would result also in efficiency, is for the landlord to share with the tenant the cost of non-labour inputs. If the landlord and tenant share the cost of the input in the same proportion at which output is divided between them and the choice of the input is left to the tenant then he would indeed choose the level where the price of the input is equal to the marginal

product. However, if the input is not traded, e.g. tenant's labour, then the landlord will have to set it.

Another study which looked at the simultaneous determination of the rental contract and land rented in a perfectly competitive market was provided by Bardhan and Srinivasan (1971). Using the neo-classical tools of utility maximization, Bardhan and Srinivasan arrived at a model in which the rental share and land rented are jointly determined by demand and supply for land. On the demand side, the tenant (landless labourer), has the option of leasing in land from the landlord and paying a rental percentage r of the total product or working in the market for the exogenously determined wage rate, w. The tenant then maximizes a utility function of consumption and leisure:

$$U^1(C^1,\ 1-L_1-L_2) \tag{13}$$

where $C^1 = (1-r)F(H,L_1) + L_2 w$

The equilibrium conditions yield results similar to those obtained by Johnson (1950), namely:

$$(1-r)\ \frac{\partial F}{\partial H} = 0 \tag{14}$$

$$(1-r)\ \frac{\partial F}{\partial L_1} = w \tag{15}$$

On the supply side, the landlord, has the option to cultivate land with the use of own and hired labour or to lease out land to share croppers. In this case the landlord maximizes

$$U^2(C^2,\ 1-L) \qquad (16)$$

where $C^2 = G(1-q,\ L+L_2) - wL_2 + rF(q, L_1)$

and G is the production function in the landlord own cultivation and assuming that the landlord owns one unit of land, q is the amount of land he leases out to share croppers retaining 1-q for his own cultivation; L_2 is the amount of hired labour and L the amount of own labour and L_1 the amount of labour the share cropper puts in leased out land.

The first order conditions for a maximum implies

$$G_1 = rF_1 \ ; \ G_L = w \qquad (17)$$

The first condition in (17) means that the marginal product in self cultivation should be equal to the share of the marginal product of land that the landowner received from leased out land. The second implies that the marginal product of labour in self cultivation should be equal to the wage rate.

Applying the comparative static techniques to the first order conditions of maximization for both tenants and landlords, Bardhan and Srinivasan found that the demand for land and supply of leased land are declining functions of r, i.e. $\frac{\partial H(r)}{\partial r} < 0$ and $\frac{\partial q(r)}{\partial r} < 0$. In Figure 6.2 we will have

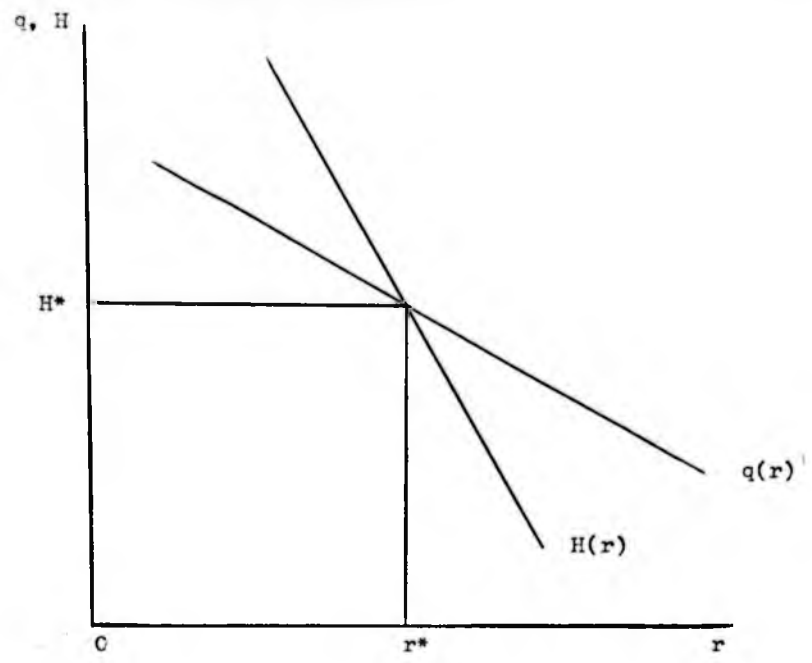

FIGURE 6.2

(H^*, r^*) are the equilibrium quantity of land leased and the rental share respectively. Bardhan and Srinivasan claim that this equilibrium is stable. A critical appraisal of the model was given by Newbery (1975). One problem with the model as he points out is that the market for land lease cannot be competitive. The reason for this is that condition (14) with a concave production function implies excess demand for land;

> "tenants will earn intra marginal surpluses no matter what the rental share and the landlord will be faced with excess demand, so that each

landlord is a potential monopolistic" (Newbery, 1975, p.123).

It is not only that this equilibrium is non competitive but also unstable, in the sense that "it would tend to be replaced by efficient contractual tenancies" (p.127).

Another important aspect of Newbery's contribution is the extension of Cheungian analysis to deal with uncertainty, where he arrives at the result that share cropping is just as efficient as under certainty. However, Newbery went on to show that under conditions of perfect competition and constant returns to scale, share tenancy is at best equivalent to a combination of fixed-rent and fixed wage contracts (Newbery, 1975, p.116; see also Bliss and Stern, 1982, pp.61-62). This, then, demonstrates that neoclassical assumptions fail to attribute any advantage to share tenancy and implies that other factors should account for the widespread prevalence of share cropping contracts. This brought Newbery to the consideration of uncertainty and how it is related to the choice of the form of contract. According to Newbery the uncertainty which characterizes agricultural production leaves its marks on the prospects of employment during the agricultural season in such a manner that job-hire becomes uncertain. Under such conditions it becomes impossible for labour to enter into a variety of contracts, e.g. fixed rent and wage contract each with a certain return. Bearing this idea in mind, together with its implications of high enforcement costs for the landlord, the following equilibrium conditions hold:

$$(1-r)F_L = wP \qquad (18)$$

$$rF(H,L) = \bar{R}H \qquad (19)$$

where F_L is the marginal product of tenant's labour and $\bar{R}$ is the fixed rent per acre considered equivalent in risk to the average rent under share tenancy and P is the probability of finding a job off farm in the days available for wage employment. Equation (18) gives the equilibrium condition of the tenant and (19) of the landlord. The equilibrium in (18) is different from the Cheungian analysis in two respects. Firstly, the wage rate is discounted by the probability of finding an off-farm job which introduces uncertainty into the equilibrium condition. Secondly, the discounted wage is equated to the tenant's share of marginal product and not to the full marginal product as shown previously. This results in an increase of the level of applied labour (in Figure 6.1 MC would shift downward) and hence an improvement in the level of efficiency. The equilibrium side of the landlord in (19) has the required property that the contract yields the desired average rent $\bar{R}$. Newbery's conclusion is that the difficulty of enforcing the input levels leads to landlords restricting the size of tenancy and that the existence of uncertainty

> "makes share cropping more attractive to landlords (since enforcement costs are reduced), while it is likely that the same mechanisms that give rise to uncertainty in the labour market provide an incentive to the tenant to seek share contracts and spread risk" (p.132)

In Section 6.4 we will discuss and empirically examine a model of tenancy which captures the departure from the neoclassical assumptions of identical and constant returns production function and introduces factor market imperfections in the determination of tenancy.

6.3 Type of contract in the villages

Among the cultivating households in our sample the majority of the population renting in/out land did this for a fixed annual cash rent. The contract known as dugundi, usually expires by the end of the agricultural season. Only two cases of share cropping were observed. Table 6.1 shows farm classification in the sample.

Table 6.1 : Farm classification in the sample

Farm type / Village	Owners		Tenants		Owner-Tenants	
	No.	%	No.	%	No.	%
Tamari	24	49	16	32.6	9	18.4
Tebeib	20	62.5	4	12.5	8	25
Umshaniq	14	77.8	1	5.5	3	16.7
Wad-el-Kashif	11	28.9	18	47.4	9	23.7
Meallyab	7	58.33	1	8.33	4	33.3
All	76	51.0	40	26.8	33	22.2

As the table shows 51% of the household cultivators owned their land. When to this is added the 22.2% of the part owner cultivators (those leasing in land in addition to owned plot), the number of cultivating land owning families is some 73%. On the other hand more than a quarter of those who cultivated are landless tenants.

Now, the theories given in Section 6.2 concentrate mainly in discussion of efficiency of share cropping compared to fixed cash rent and own cultivation. As we have seen they predict that share cropping could be as efficient as own or fixed rent cultivation and that under

under the latter tenants are as efficient as owner cultivators. The theories thus do not conceive of the possibility that fixed-rent tenancy output might differ from owner-cultivated. It is quite possible, however, that tenants on fixed rent cultivation may be less efficient than owner cultivators. Tenant farmers may be poor and own no capital of their own compared with land owning farmers. Where land is the only means of collateral a tenant farmer's credit worthiness may be reduced and he might not be able to obtain enough credit to augment his working capital. Tenant farmers may thus fail to apply inputs to the same intensities as owner farmers. In addition to this farmers' decisions relating for example to sowing time, fertilizer use, following behaviour or irrigation investment may be related to the degree of risk aversion, the more risk averse choosing conservative options (Binswanger, 1981). Further, under conditions of uncertainty that surrounds agricultural cultivation, one would expect a risk averse profit-maximizing farm firm to produce less output than under certain conditions. Thus if tenant farmers are poor and more risk averse than own cultivators we might expect them to produce less than the latter.

Table 6.2 shows the mean inputs and output per feddan for the different types of farms in the sample.

The figures in 6.2 show that average output per feddan in owner-operator farms is 10.9 keilas which is a little higher than average productivity in tenant farms, which is 9.9 keilas per feddan. The figures also reveal a difference in the input mix between the two groups with more labour applications per feddan for the group of tenants than for owners. On the other hand the group of owners

Table 6.2 : Mean inputs and output in different Types of Farm

Type of Farm	No. of Observations	Output Values per feddan (in pounds)	Yield per feddan (in keila)	Yield per manday (in keila)	Mandays per feddan	Machine hours per feddan
Owners	76	19.83 (1.69)	10.93 (0.902)	2.171 (.29)	9.14 (.834)	0.11 (.014)
Tenants	40	18.03 (1.63)	9.9 (0.86)	1.55 (o.27)	10.64 (1.85)	0.095 (.02)
Owner-Tenants	33	20.01 (1.71)	11.57 (0.95)	2.59 (o.40)	8.84 (.99)	0.10 (.01)

Notes: Figures in parentheses are standard errors

seemed to have used on average more machine hours than tenants. As a consequence we see that yield per manday for owners is higher than that for tenants which should be interpreted in view of the fact that machine use reduces the number of days worked in the field to a large extent.

6.4 Determination of Leased-in Land

In this section we would look at the factors which determine the amount of net land leased in (land leased in minus leased out) for the group of land owning farmers. For the explanation of land leased in we are going to use a model developed by Bliss and Stern (1982, pp. 146-151) for the determination of tenancy irrespective of the form which it takes. Bliss and Stern pointed to the general nature of the model which prompts to offer further explanations for tenancy that follows from abandoning the assumptions of identical production function for all farmers and constant returns to scale in production.

According to Bliss and Stern tenancy would have a role to play whenever any productive input is less than perfectly marketable. For Palanpur in India the authors singled out two such factors: family labour and bullocks which provide draught power. If one assumes that these two inputs were fixed at the beginning of the season, then the question becomes one of the determination of the amount of land which the farmer would like to cultivate. In order to determine this the notion of "desired cultivated area" (DCA), was introduced. It was defined roughly as that "area which accords best with the factor supplies available to the household" (p.144). Leasing in or out is seen as an adjustment of land owned towards DCA. Below we give a

formal presentation of the model and introduce the variables which we are going to use.

6.4.1 The model

(i) The Variables:

y : Net land leased in (NETLIN)
G : Desired Cultivated Area (DCA)
Z : Owned Land (OWNDLAND)
x_1 : Adults in the household (DADULTS)

(ii) The specification:

$$y = G-Z \tag{20}$$
$$y = f(G,Z) \tag{20.1}$$
$$y = f(G-z),\ f(0) = 0,\ 0 \leq f' \leq 1 \tag{20.2}$$
$$G = G(x_1),\ G' > 0 \tag{21}$$
$$y = f(G(x_1) - Z) \tag{22}$$

Equation (20) would hold if adjustment were complete, i.e. land leased in minus land leased out would simply be the difference between (DCA), G, and land owned, Z. (20.1) is a more general specification of the model. A special form would make y depend only upon the difference between DCA and land owned as in (20.2). According to Bliss and Stern adjustment of land cultivated to desired cultivated area will not in general be complete. One reason for this might be the costs which would be associated with involvement in the market for leased land and these are represented by the difference between the function f( ) and the identity function (f(y) = y). For example a tenant might find some difficulties in finding a landlord who would lease to him the land he would desire to cultivate. There are also difficulties associated with leasing as such, e.g. interference

by landlords in cultivation, which is not relevant in our case because of fixed rent arrangements. However under thelatter a disutility might be attached to leasing in land were the tenant to make some investments in improving the hired-in land. Since he knows that he would hold the land for a short period the tenant might end up by leasing less than he desires.

In (20.2) two restrictions are imposed on f. First, $f(0) = 0$, means that a household which owns its DCA will cultivate its desired cultivated area; that is neither lease in nor lease out. Secondly, if f is differentiable, $0 \leq f' \leq 1$, which means that f should be non-decreasing function of G-Z, i.e. the more DCA exceeds the amount the household owns the more it will wish to lease in, and that if the difference is increased by one small unit the effect will be to increase leasing in by at most that unit.

In (21) desired cultivated area is given as a function of the number of adults in the households, x_1. In Bliss and Stern (1982) the value of bullocks owned by the household is included in DCA in addition to adults in the household. Below we will give an explanation for inclusion of x_1 only for our sample. The restriction in G is that $G' > 0$, that is, desired cultivated area should not decrease with the number of adults in the household, x_1.

(22) gives the model of leasing which we are going to use to test the data in our sample. Before plunging into the question of algebraic specification of (22) we give some reasons for the inclusion of x_1 as a determining factor of desired cultivated area and how we measure it. Other variables which we like to include in the determin-

ation of y will also be discussed.

In our specification, x_1 will be the number of adults (males and females) aged 15 years and over and who participated in the agricultural season. The inclusion of adult females relates to the nature of cultivation in the sample we have. In the sample part of the land was often not subjected to the axe or tractor ploughing and was left for okra to grow in. Okra picking operation is left mainly to females in the household. It thus seems plausible to include females in the determination of DCA.

As we have explained earlier in Section 3.3, a market for hired labour exists in the villages but the attitude of most people is to till one's own family land or lease in and cultivate rather than offer one's labour in the market. And as was made clear for us the bulk of agricultural workers come from other villages where rainfall was meagre during that season. This indicates that one can assume that within the villages labour is more or less imperfectly marketable. Hence $G = G(x_1)$.

Beside land-owned and adult labour in the household we think that other factors may be important in explaning land leased in by the family. One possible factor which might induce leasing is the availability of tractors, which are usually hired in the villages. The presence of a tractor might encourage landowners to increase the size of their farms, particularly those who can financially do so. This is so because the tractor makes the operation of ploughing and sowing much easier than when it is done by hand. However the number of tractors were limited and two of the three tractors which

were available to the villages come from outside. Difficulties were also experienced by some of the cultivators in hiring tractors and had to wait for days before it could be brought to plough land. Services of the tractor are often biased towards those who would like to cultivate all the land they owned and not only part of it as happens sometimes. To take account of tractor influence in our empirical study of leasing we decided to use two dummy variables: M1 which takes the value of 1 if the ratio of land cultivated by the tractor to total cultivated area is positive but less than 1 and zero otherwise and M2 which takes the value of 1 if all land is cultivated by tractor and zero otherwise.

Turning to the question of algebraic specification of (22), a linear approximation to (21) and (22) will give an approximation to (22) as follows:

$$y = \alpha_1 b x_1 - \alpha_1 Z + \alpha_o \qquad (23)$$

where $\alpha_1 = \frac{df}{dG}$, $b = G' = \frac{dG}{dx_1}$ and α_o is a constant.

Rewriting (23) and including M1 and M2

$$y = \alpha_o - \alpha_1 Z + \alpha_2 x_1 + \alpha_3 M_1 + \alpha_4 M2 \qquad (24)$$

where $\alpha_2 = \alpha_1 b$, which is a product of α_1, which measures the responsiveness of leasing to a deviation of desired cultivated area from owned land, and b, which measures the marginal responsiveness of desired cultivated area to the number of adults in the household. Equation (24) will be the basic equation which we would use in the

empirical analysis of next section. The regression equation based on (24) will be

$$y = \alpha_o - \alpha_1 Z + \alpha_2 x_1 + \alpha_3 M1 + \alpha_4 M2 + E \qquad (25)$$

where E is an error term with zero mean and constant variance.

In addition to owned land and the number of adults in the household we would also like to examine the effect of some other variables in the demand for land. One such variable which might have an influence is the animals which the household owns. Animals usually feed on the straws of sorghum which is sown by farmers. Sorghum straws are collected and stored and animals are fed on them for the period of the dry season. Sorghum grains could also be served to animals if the family realizes a surplus over its own needs. It is possible then that a household who owns a large number of animals might be motivated to lease in more land in order to provide adequate amounts of food for the family and animals it owns. In order to examine the influence of animals in the demand for land the variable which we will use will be the total market value of animals owned by the household (VANM), where value is measured in pounds.

Another variable which we like to introduce in the analysis is the land owned per standard family member and which is also used by Bliss and Stern (1982). We will define this as

$$OWFAM = \frac{\text{Land owned (OWNDLAND)}}{0.5\ \text{children}_1 + 0.7\ \text{children}_2 + .9\ \text{women} + \text{men}}$$

The coefficients used in the denominator are those which are employed in Section 4.4.2 in the study of consumption. Children_1 are those whose age is less than or equal to seven years while children_2 are those who are aged between 8 and 14 years. Men are the adult men in the household and women are adult women in the household. The reason for using OWFAM is that a family owning less land than the amount which could cater for the standardized number of its family would tend to lease in land.

Another variable is the number of adult members working outside the villages, (UBAD), mainly in the informal sectors in urban areas. The idea is that if more members of the family leave home, the family's requirement of food may be reduced thereby resulting in less demand for land to cultivate. But members of family away from the village keep in contact with their families and send money remittance to them. These remittances could be used to hire in land or pay for the services of labour and tractor. Thus income remittance (INCMREMT) will also be used as a determining variable of net land leased in. We must also be cautious in the expectation of the way remittances may have on demand for land. Remittances could as well be used to purchase the requirement of food in the market and reduce demand for land.

6.4.2 The Regression Analysis

In this section we look at the results of ordinary least squares

estimation of equation (25). The results are shown in Table 6.3. The table gives the estimated coefficient attached to each one of the variables included in (25), its standard error and F value. Included in the table also are the estimated coefficients and their corresponding F values of the other variables we discussed in 6.4.1, were they to be included in the regression among the main determining factors. These are value of animals owned by the family (VANM), land owned per equivalent adult (OWFAM), number of adult members working in urban areas (UBAD) and income remitted home by these members (INCMREMT).

Table 6.3 : Regression Result : Dependent Variable NETLIN
Variables in the equation

Variable	Coefficient	Standard error	F
DADULTS	1.51	0.63	5.73
OWNDLAND	-0.226	0.05	16.66
M1	2.41	2.08	1.34
M2	3.31	1.62	4.16
Constant	-0.16		
Multiple R	0.396	Number of cases	109
R Squared	0.157	Number of variables	4
Standard error	7.53	F-value of equation	4.86

Variables not in the equation

Variable	Coefficient	F
VANM	0.287	8.23
OWFAM	-0.07	0.57
UBAD	-0.01	0.01
INCMREMT	-0.09	0.29

Notes: (1) For definition of variables see Section 6.4.1.

(2) The tabulated value of F at 5 per cent level of significance and (4,60) degrees of freedom is 2.53.

(3) Standard error is the standard error of estimated equation.

The results in Table 6.3 indicate that the coefficients attached to DADULTS, OWNDLAND and M2 are significantly different from zero at the five per cent level of significance. The coefficients also confirm our a priori expectation of the direction of change which each of the variables would have on land leasing. Land owned is inversely related to net land leased in, i.e. an increase in land owned would lead to less land being hired. The coefficient attached to land owned is -.226 with a standard error equal to 0.05, indicating that one lies outside the 95% confidence interval for the estimated coefficient. This coefficient as shown earlier (a_1 in equation (23) and (24)) measures the marginal response of net land leased in to a deviation of owned land from desired cultivated area. Being less than one this means that the adjustment of desired cultivated area is not complete. The estimated coefficient also shows that the response of land area used to an increase in land owned will be about 23% of the increase. This is lower than the value estimated for Palanpur by Bliss and Stern. However, we can attribute this lower value to the fact that the farmers in our sample cultivated only a staple crop which is used for subsistence. Thus an increase in owned land under the present conditions of agriculture, where land is only cropped once in the whole year and agriculture is not commercialized, may not lead to substantial marginal increases in land allocated to cultivation. Another reason is that land owners may like to leave more of an increase in land fallow and use it as pastoral ground for grazing the animals which significantly influence land lease as the results in Table 6.3 show.

Secondly an increase in the number of working adults in the household will lead to an increase in demand for land. As explained earlier the coefficient on DADULTS is the product of a_1 which

measures the responsiveness of leasing to a deviation of desired cultivated area from owned land, and b which measures the marginal responsiveness of desired cultivated area to the number of adults in the family (see equation (23)). In order to get the coefficient which measures the response of desired cultivated area to an increase in the number of adults, the coefficient which is attached to DADULTS will be divided by that on OWNDLAND. From Table 6.3 we will have, 1.51/.226 = 6.68. This means that a family with an additional adult member would like to use an additional 6.68 feddans. This figure can be compared to the average ratio of land cultivated to adults in the villages which is 5.21 feddan.

The positive coefficient on the dummy variable M2 indicates that the group of land owners who used the tractor to plough all the land which they cultivated increased the size of their farms by leasing in. Thus we can say that use of tractors encourage cultivation of more land. If we look back at equation (24) we notice that when M2 = 1 and M1 = 0, then the constant in the equation will be given by $\alpha_0 + \alpha_4$. Thus for the group whose farms were "fully" mechanized the estimated functional form will have a constant equal to 3.15. On the other hand tractor use is not a significant explanatory factor of leasing for the groups which used it in only part of their land.

Turning to the 'variables not in the equation' we can see as Table 6.3 shows, that only one variable is highly significant as a determining factor of net land leased in. This is the value of animals owned by the household (VANM). The coefficient on VANM is positive. This means that a family which owns more animals will tend

to lease in more land. The non significance of the other variables which are not included in the basic equation can be ascribed to the linear relationship which some of these variables have between themselves or with the variables included in the equation. For example OWFAM = $\frac{1}{\Theta}$ OWNDLAND, and is highly correlated with OWNDLAND as the correlation coefficients matrix of the variables had shown us.

The second test for evaluation of parameter estimates of equation (25) shown in Table 6.3 is provided by looking at the value of R^2 which measures the dispersion of observations around the regression line.

$$\hat{y} = \hat{\alpha}_o - \hat{\alpha}_1 Z + \hat{\alpha}_2 x_1 + \hat{\alpha}_3 M_1 + \hat{\alpha}_4 M2$$

R^2 is a measure of the goodness of fit of our linear regression which shows the percentage of the total variation of the dependent variable that can be explained by the independent variables. From Table 6.3, $R^2 = 0.16$. This is rather a low value. One reason could be because we left out an important explanatory variable, that is, VANM from the equation. In order to test for this we included VANM among the main explanatory variables and estimated the new equation. The results are shown in Table 6.4. We did not find it worth while to report the results for the other variables which were not included in the equation since all the parameters are not significant as before.

There is an improvement in the value of R^2 which results from the inclusion of the additional variable, VANM, in the equation. Now the explanatory variables account for 22% of the total variation in the dependent variable, net land leased in. Still this leaves

Table 6.4 : Regression Results : Dependent Variable NETLIN

Variable	Coefficient	Standard Error	F
DADULTS	1.39	0.61	5.162
OWNDLAND	-0.30	0.06	25.54
VANM	0.06	0.02	8.23
M1	2.25	2.01	1.24
M2	3.36	1.57	4.56
Constant	-0.27		

Multiple R	0.46	Number of cases	109
R Squared	0.22	Number of variables	5
Standard error	7.28	F value of equation	5.80

Note: (1) For definition of variables see 6.4.1.

much of the variation in the dependent variable to be attributed to factors which are unknown and which are included in the error term E. Though unquantifiable factors can be incorporated in the model (e.g. as we did with M1 and M2), some of these might not be easily included. For example, the effect of good weather requires observations over a period of time and the use of rainfall indices over a number of years.

Bliss and Stern also expressed their discomfort about the linear approximation for the function f( ) because in doing so one assumes that the adjustment of land cultivated to land owned operates in the same way and with the same force regardless of the sign of DCA-OWNDLAND. In other words, the model as tested does not allow adjustment to operate more freely and easily for leasers-in than it does for leasers-out, or conversely. In order to incorporate non-linearities in f in the analysis we have estimated the following

quadratic form:

$$NETLIN = \alpha_o - \alpha_1 \text{ OWNDLAND} + \alpha_2 \text{ DADULTS} - \alpha_3(\text{OWNDLAND})(\text{DADULTS}) + \alpha_4 (\text{OWNDLAND})^2 + \alpha_5(\text{DADULTS})^2 + \alpha_6 \text{ M1} + \alpha_7 \text{ M2} + E \quad (26)$$

where the new terms in (26) we define as follows:

$(\text{OWNDLAND})^2$	:	OWNSQ
$(\text{DADULTS})^2$	:	DADSQ
OWNDLAND X DADULTS	:	OWDAD

The estimated coefficients for equation (26) are shown in Table 6.5.

Table 6.5 : Regression Results : Dependent Variable : NETLIN
Variables in the equation

Variable	Coefficient	Standard error	F
DADULTS	2.72	2.91	0.87
OWNDLAND	-0.27	0.20	1.77
OWDAD	-.03	0.001	1.83
OWNSQ	0.002	0.04	0.45
DADSQ	-.08	0.45	0.03
M1	2.68	2.12	1.59
M2	3.24	1.68	3.72
Constant	-1.63		

Multiple R	0.419	Number of cases	109
R Square	0.175	Number of variables	7
Standard error	7.56	F-value of equation	3.07

Table 6.5 (cont'd.)

Variables not in the equation

Variable	Coefficient	F
VANM	0.28	7.72
OWFAM	-.16	0.57
UBAD	-.06	0.39
INCREMT	-0.3	0.12

Notes: (1) The variables as defined in 6.4.1 and above.

(2) The critical value of F at 5 per cent level of significance and (7,60) degrees of freedom is 2.17.

The results of the quadratic form shown in Table 6.5 indicate that this form does not produce results more convincing than those produced by the linear form. The significance of the main variables OWNDLAND and DADULTS is obscured now. Only the dummy variable M2 is significant. Among the variables not in the equation VANM is still the only significant factor.

Another way which is followed by Bliss and Stern is to split the sample into leasers-in and leasers-out and fit the basic equation (equation (25) in our case) by ordinary least squares and compare the results. However, the authors expressed their cautious reservations about such an exercise. For, as they have explained, if the basic model is correct (i.e. there is no difference between the response of land cultivated to discrepancy between DCA and OWNDLAND for those owning more than DCA and those owning less) splitting of sample would result in violation of the classical assumptions on the error term (p.163). The results of estimating equation (25) for the group of leasers-in (NETLIN > 0) and the group of leasers-out (NETLIN < 0) are shown in Table 6.6 and 6.7 respectively.

Table 6.6 : Regression Results : Dependent Variable : NETLIN

Variables in the equation

Variable	Coefficient	Standard error	F
DADULTS	1.12	1.23	0.819
OWNDLAND	-.004	0.19	0.001
M1	0.39	3.94	0.01
M2	8.14	3.60	5.11
Constant	4.32		
Multiple R	o.462	Number of cases	33
R square	0.21	Number of variables	4
Standard error	8.40	F-value of the equation	1.89

Variables not in the equation

Variable	Coefficient	F
VANM	0.50	10.12
OWFAM	-0.11	0.13
UBAD	-0.41	4.32
IMCMREMT	-o.12	0.43

Notes: (1) The regression results presented above are for the groups of leasers-in i.e. NETLIN > 0

(2) The critical value of F at 5 per cent level of significance and (4,30) degrees of freedom is 2.69.

Table 6.7 : Regression Results : Dependent Variable : NETLIN

Variables in the equation

Variable	Coefficient	Standard error	F
DADULTS	-0.95	1.55	0.37
OWNDLAND	-0.25	.10	6.18
M1	1.34	6.62	0.04
M2	0.67	4.64	0.02
Constant	0.58		
Multiple R	0.909	Number of cases	8
R square	0.826	Number of variables	4
Standard error	4.62	F-value of the equation	3.57

Variables not in the equation

Variable	Coefficient	F
VANM	0.89	7.64
OWFAM	0.35	0.08
UBAD	-.21	0.11
INCMREMT	0.06	0.02

Notes: (1) The regression results presented above are for the group of leasers-out i.e. NETLIN < 0.

(2) The critical value of F at 5 per cent level of significance and (4,8) degrees of freedom is 3.84.

The results in Tables 6.6 and 6.7 may be compared with those in Table 6.3. We can see that for the group of leasers-in the coefficient on OWNDLAND is much smaller and is not significantly different from zero at 5 per cent level of significance. For leasers-out the coefficient on OWNDLAND is not different and is a bit higher -0.25 compared with -.23 in Table 6.3. This would suggest that adjustment is stronger for leasers-out than for leasers-in. One possible explanation is that unlike leasers-out, leasers-in might attach a disutility

to taking land on lease. As we have said earlier, tenants hold land only for a short period of time. Hiring in land would involve some improvements, e.g. clearing, building of terraces, the cost of which is borne only by the tenant and the returns from which might extend over more than a year. The presence of such "externalities" might induce leasers-in to end up hiring less than the socially optimum. Another explanation is that the market for land might be a seller's market in that it is easier for a land-owner to find a tenant than for a tenant to find a land-owner.

The coefficient on DADULTS on both Tables 6.6 and 6.7 is now not significantly different from zero at 5 per cent significance level. In fact in Table 6.7 it has a negative sign. This is not so in the results for the basic equation in Table 6.3.

The results in Tables 6.6 and 6.7 show also that while M2 is significant for leasers-in it is not so for leasers-out. This suggests that those who leased in were induced to do so partly because of the possibility of using the tractor in all the land they would cultivate. Another thing is that among the 'variables not in the equation' VANM is significant for both leasers-in and leasers-out. In addition to this, for leasers-in, the number of adults working outside the villages now has a significant influence on leasing in. The coefficient on UBAD implies that as more of the family adult members stay away less land will be leased in for cultivation.

The results of splitting the sample is suggestive in a number of ways. Firstly the adjustment of land cultivated to desired cultivated is stronger on the side of leasers-out. Secondly for

leasers-in the possibility of cultivating all land through the tractor is partly responsible for acquisition of more land for cultivation. Thirdly animals owned by the family is an important variable in explaining leasing for both leasers-in and leasers-out.

6.5 Conclusion

In the foregoing analsis an attempt was made at assessing the various factors that determine the size of net land leased in our sample of villages. The theoretical model explained in 6.3 which underlies this objective should be evaluated in relation to the statistical tests of reliability of its empirically estimated parameters. The two main factors included in the basic linear model, namely, OWNDLAND and DADULTS, turned out with the right sign and were statistically significant in explaining the variance in net leased land. The results also indicate that a household with an additional adult member would like to use an additional 6.68 feddans. The dummy variables used to test for the effect of mechanization in leasing showed that access to mechanical cultivation could have a significant influence. The explanatory power of the model on the other hand, was not potent enough. Some small improvement in the explanatory power occurred with the inclusion of an additional significant variable among the basic explanatory variables, viz, VANM. We were unable, however, to think of any other measurable factors that might have affected leasing. In order to take account of non-linearities in the function f( ) a quadratic form was used. The latter produced very poor results.

CHAPTER 7 - Rural-Urban Migration

7.1 Introduction

Migration of people from rural to urban areas in search of better employment opportunities is an important issue which faces developing countries today. Coupled with the limited capacity of a still small and growing industrial urban sector in most of these countries this tendency has culminated in high rates of urban unemployment and contributed to rapid rates of growth of the urban sector. Some of the available statistics of rural and urban rates of growth shows that between 1950-60, the population of urban areas in Africa grew by 69% while rural areas grew by only 20% over the same period (Turnham, 1971, p.107). In Sudan the population of large towns has increased from 6.4% of the total population in 1955/56 to 13.4% in 1974/75; that is to say the percentage of the population of large towns to total population has doubled in the last twenty years. Results of a sample survey in 1971 of migration to the capital city have shown that of the 700 thousand population of the city in that year 40% were migrants. Among the population of 15 years and above 60% of them were migrants. Among the heads of households 70% were born outside the capital and came at some stage of their life (Galal El Din and El Mustafa, 1979, pp.128-132). It is clear, therefore, that migration plays a significant part in the growth of the population of urban centres in Sudan and in particular of the capital city which attracts most of the migrants.

In the following sections we are going to look at the various issues involved in rural-urban migration, both the theoretical models and the attempts to formulate testable empirical models of the theory.

We look also to rural-urban migration in the villages and concentrate on the factors that act as an inducement to migration as related to decisions carried at the household level. Section 7.2 reviews the main stream of the literature in migration and some of the recent developments. Section 7.3 looks at the general framework of the empirical treatment and Section 7.4 at the problems surrounding it. In 7.5 we look at migration in the villages; 7.5.1 portrays the general features of migration while in 7.5.2 we proceed to a specific setting of the variables that we assume the households perceive in formulating decision to migrate and discuss the model we want to estimate. In 7.5.3. the results of the regression are given. Section 7.6 gives the concluding remarks and implications.

7.2 Rural Urban Migration in theory

In most of the theoretical models which dealt with rural-urban migration the process was viewed as a purposeful response to differences in economic opportunities between rural and urban areas. In the work by Todaro (1969) an individual migrates if his expectations are such that the costs, money and non-money (e.g. psychic costs) of migration are equal to or less than the difference in the present discounted values of the stream of benefits in the source and receiving areas. Let $Y_u(t)$ and $Y_r(t)$ be the average real incomes of individuals employed in the urban and rural economy, T the number of time periods in the migrant's planning horizon and i the discount rate reflecting the migrant's degree of time preference. The present discounted value, V(O), of the expected urban-rural income differential will

be given by

$$V(0) = \sum_{t=0}^{T} \frac{(P(t)Y_u(t) - Y_r(t))}{(1+i)^T} \qquad (1)$$

where $P(t)$ is the probability that a migrant will have secured an urban job at the average income level in period t. If $C(0)$ represents the cost of migration, the decision to migrate or not will depend on whether

$$V(0) - C(0) \geq 0 \qquad (2)$$

Denoting the amount of rural-urban migration, M, by $\dot{L}_u$ (where L_u is the total urban labour force and a dot means the rate of change in the variable with respect to time) we can write

$$M = \dot{L}_u = F(V(0),R) \qquad (3)$$

where $V(0)$ as defined above and R is a vector of other variables that influence migration and which includes among its arguments $C(0)$. Assuming that the process of job selection from the pool of labour in urban areas (urban permanent labour plus migrants) is random, Harris and Todaro (1970) express the probability of getting a job in any single period as

$$P = \frac{Lm}{Lu} \qquad (4)$$

where Lm is the number of urban jobs and Lu the urban labour force. Lm/Lu therefore represents the perceived urban employment probability. Now let the income of individuals in rural and urban areas be represented by Wa and Wu, where Wa is the nominal agricultural wage and Wu is the urban wage rate. The expected urban income in a single period EWu is

$$EWu = Wu \frac{Lm}{Lu} \qquad (5)$$

using (4).

Expected rural income $EW_a = W_a$. The amount of rural urban migration $\dot{L}_u$ is a function of the urban-rural expected wage differential, thus

$$\dot{L}_u = F(W_u \frac{Lm}{Lu} - W_a) \qquad (6)$$

Migration will cease when the expected income differential is zero. Thus the rural-urban equilibrium condition is

$$Wu \frac{Lm}{Lu} = Wa \qquad (7)$$

From (7) the Harris-Todaro model predicts as a first approximation an "equilibrium" urban employment rate given by

$$\frac{Lm}{Lu} = \frac{Wa}{Wu} \qquad (8)$$

or alternatively an unemployment rate given by

$$1 - \frac{Lm}{Lu} = 1 - \frac{Wa}{Wu} \qquad (9)$$

(9) illustrates the negative relationship between expected urban-rural wage differences and the rates of equilibrium unemployment.

One feature of this model is said to be the high rates of unemployment which it predicts when compared with the actual observed rates in some developing countries. With per capita incomes in urban areas twice and sometimes eight times those in rural ones in some developing countries (Turnham, 1971, p.77), (9) will predict rates of unemployment of between 50% and 88%. Evidence available indicates that the highest unemployment rate recorded in seventeen developing countries is 20% (Turnham, 1971, p.57).

Some reasons were suggested for this divergence of the predictions of the model from actual observed evidence. It has been argued that the Harris-Todaro specification is characterized by very rapid labour turnover. Johnson (1971) examined some aspects of the theory of rural-urban migration with emphasis on a couple of extensions; the introduction of the phenomenon of income sharing of the employed with the unemployed, through some form of extended family system, and the rate of labour turnover within the urban market. Johnson, like Todaro (1969) postulates that the potential migrant is an income maximizer of the expected urban-rural income differential. Letting α be the fraction of income of employed persons which is subject to sharing ($\alpha < 1$), Johnson defines the actual income in urban areas as

$(1-\alpha)W_u + \alpha W_u n$ for the employed and $\alpha W_u n$ for the unemployed, where W_u is the urban wage rate and n is the urban employment rate. If P is the probability that an individual will be employed at a point in time, urban expected income at that time will be equal

$$EW_u = (1-\alpha)W_u P + \alpha W_u n \qquad (10)$$

which says that the expected urban income is equal to the fraction of income which he retains after sharing, $(1-\alpha)W_u$ with probability P if he is employed, and his share in the income of the employed, $\alpha W_u n$, if he remains unemployed. Equilibrium will attain when $EW_u = W_a$, i.e.

$$(1-\alpha)W_u P + \alpha W_u n = W_a \qquad (11)$$

Assuming that there is complete income sharing, i.e. $\alpha = 1$, from (11) the equilibrium employment rate n will be given by W_a/W_u as in Harris-Todaro model. Johnson also demonstrated that the fraction of people who move to the urban areas at any point of time varies directly with the fraction of income of employed persons which is subject to sharing. An intuitive explanation for this seems to be the support which a prospective migrant expects to receive from his employed kin, relatives or acquaintances when he arrives at the town. Johnson also worked the relationship between the fraction of people who move to urban areas and the rate of labour turnover and has shown that they vary directly (p.24).

Another reason for the implications of high unemployment rates in the Harris-Todaro model derives from the specification of the

probability of employment in the urban sector which is defined as the number of urban jobs divided by the urban labour force. According to Fields (1975), this specification assumes that persons living in rural areas have no chance of finding urban jobs and that a lower unemployment equilibrium will be predicted by introducing a more generalized formulation of the job search process in the model. Fields introduces a rural-urban job-search parameter, $n < 1$, which he defines as the relative chance of any given rural worker obtaining an urban job, that becomes available, relative to any given urban worker. He assumes that the value of n in any given country "depend on a number of economic and cultural variables including the length of the work week in agriculture, the extent of favouritism, nepotism, and discrimination in the labour market, and the efficiency of labour exchange" (p.169).

To incorporate the job search parameter n in Harris-Todaro model, Fields proceeds as follows. Let the probability of a given urban resident becoming employed in an urban job be P_u. Assuming that all jobs are available to all equivalent seekers equally,

$$P_u = E_u/J_u \qquad (12)$$

where E_u is urban employment and J_u is the number of job seekers equivalents and is a weighted form of the urban and rural labour force, the weights reflecting the relative chances of being hired. Since each rural resident has only an nth as great a chance of being hired,

a weight of one is assigned to each urban resident and a weight of n to each rural resident. With L_u and L_a being the number of residents in urban and rural areas respectively, J_u will be defined as

$$J_u = L_u + n L_a \tag{13}$$

If a rural resident is hired for an urban job he would earn the urban wage rate W_u with probability nP_u; otherwise he expects the rural wage W_a with probability $(1-nP_u)$. Therefore the expected income of a member of the rural force is

$$EW_a = W_u n(E_u/J_u) + W_a[1-n(E_u/J_u)] \tag{14}$$

The expected wage of a member of the urban labour force EW_u is given by

$$EW_u = W_u P_u = W_u(E_u/J_u) \tag{15}$$

The rural-urban migration condition is

$$EW_a = EW_u \tag{16}$$

Equating (14) and (15) we get

$$W_u(E_u/J_u) = W_u n(E_u/J_u) + W_a[1-n(E_u/J_u)] \tag{17}$$

In the case of $n = 0$ we are back to Harris-Todaro equilibrium employment rate. Solving for E_u/L_u after substituting (13) and

$L-L_u$ for L_a we get:

$$E_u/L_u = \frac{1 + n[(L/L_u) - 1]}{[(W_u/W_a) - n[(W_u/W_a) - 1]]} \qquad (18)$$

or alternatively solving in terms of W_a/W_u:

$$\frac{W_a}{W_u} = \frac{(E_u/L_u)(1-n)}{[(1-n) + n[(L-E_u)/L_u]]}$$

From which we can write

$$E_u/L_u = \left(\frac{W_a}{W_u}\right)^{\frac{1}{\gamma}} \qquad (19)$$

where $\gamma = (1-n)/[(1-n) + n[(L-E_u)/L_a]]$ with $n < 1$, $\gamma < 1$ and $\frac{W_a}{W_u} < \frac{E_u}{L_u}$

Further by differentiating (18) with respect to n

$$\frac{\partial (E_u/L_u)}{\partial n} = \frac{(\frac{W_u}{W_a})(L/L_u) - 1}{\left[\left[(\frac{W_u}{W_a}) - n\left[(\frac{W_u}{W_a}) - 1\right]\right]\right]^2} > 0$$

since $(W_u/W_a)(L/L_u)$ obviously exceeds unity; and the rate of employment

increases with the job search parameter, n. In Fields' analysis one way in which n can be large is through improvement in the efficiency of labour exchange.

Fields considered also the implications of introducing a "murky", traditional, informal or unorganized sector in urban areas, which in our judgement is a characteristic of urban centres in Sudan, particularly the capital. The effect of presence of the traditional sector is to provide temporary employment for those who newly arrived from rural areas. This would mean a lower unemployment than it could have been in the absence of an informal sector.

In Fields' analysis, the preference of employers for recruiting educated persons is another reason why a higher employment rate would prevail than the one which would be predicted by Harris-Todaro.

In fact one of the most consistent findings of the rural-urban migration studies is the positive relationship between educational attainment and the propensity of rural residents to migrate (see e.g. Barnum and Sabot (1976), pp.74-76). The economic explanations for this relationship are that there is an association between education and occupation in the urban areas suggesting a positive relationship between education and urban income. It is also true that in developing countries in moving from high to low skilled occupations there is a shift from labour scarcity to labour surplus, suggesting a positive relationship between education and urban employment probabilities. There is also the effect of psychic costs and returns which may vary among the educational groups. The selectivity of the formal educational system of persons who are relatively open to change or who come

from families having relatively urban oriented values with regard to occupational and consumption choices may contribute to the ability of educated migrants to be more perceptive to change and generally more informed about the employment opportunities available than their uneducated counterparts. In terms of equations (1) and (2) this means that $V(0)$ is higher and $C(0)$ is lower for the educated migrants than for the uneducated.

Some further extensions, modifications of the Harris-Todaro model and investigations of the phenomenon of rural-urban migration, its causes, consequences and remedies were provided by various writers (see Todaro (1976), pp.36-46). Among these Stiglitz (1969) looked at the allocation of labour between the rural and urban sector under different patterns of land ownership and arrangement for sharing among members of a community. He considers three polar cases : an individualistic economy where land is privately owned, a community where income is equally shared and in which after the individual migrates to the city he maintains ties with the rural community, and a community with a communal ownership of land and in which after the individual migrates he severs his economic ties with the community. He arrives at the result that under both the first and second arrangements labour allocates itself so that the marginal productivity of labour in the rural sector equals the expected urban wage. Only under the third case and with the further stipulation that there is no landless rural labouring class, will labour allocate itself between the sectors so that the average productivity of labour in the rural sector equals the expected urban wage. In this third case there is also the question of money which needs to be raised in order to finance the process of migration until the individual finds a job. If the person is able to borrow or

save money while in the rural areas, the equality between the average product and expected urban wage still holds. On the other hand, in the presence of imperfect capital markets it is more likely that a person will not leave the rural areas until he is assured of a job. In this situation the wage in the urban sector may exceed that in the rural sector by a considerable amount and still give rise to relatively little unemployment. However because of the existing high rates of unemployment in urban areas in most of the developing countries and the divergence between urban wages and average productivity in agriculture this case seems to be inapplicable in many of these economies. Nevertheless, we note that the imperfections of capital markets may explain why there could be a slower rate of migration, and hence lower unemployment, than would be the case if the cost of migration could be raised easily and at a cheap cost. This could be seen in terms of equation (2) as a higher C(0) relative to the urban-rural expected income differential, V(0). Still we should remember that the extended family and sharing arrangements in towns could mitigate against the effect of such factor.

7.3 The Empirical Approach to Rural-Urban Migration

There are two approaches to the empirical quantification of the factors that influence rural-urban migration, the relative magnitude of each factor and the direction in which each of these factors is related to the migration rates and propensities. The first is a micro-economic approach which is directly concerned with the behaviour of the individual unit, be it a single person or a household in the community, and looks to the probability or propensity of the unit to migrate from a source area i to a destination area j given its

relevant demographic and socio-economic characteristics and the differential economic opportunities in both source and receiving area. In this approach, the demographic, socio-economic features, which constitute part of the independent variables that determine the probability of migration, includes age, sex, level of education, level of skills and personal contacts and relatives in destination area. Economic opportunities are estimated by variables like the farm income, or alternatively size of land available for adult member, non-farm cash wages, the urban wage rates and job availabilities.

The dependent variable in the micro migration function reflects the probability or propensity to migrate from one region to another. The dependent variable is expressed as a binary, dichotomous variable which takes the value of 1 if an individual migrates and 0 otherwise. The estimated coefficients of the function gives information about the significance of each of the included factors, its relative magnitude in the determination of migration probability and its direction.

The other approach, an aggregated one, is concerned with the overall migration rates and estimate aggregate migration functions, which typically takes the form

$$\frac{M_{ij}}{P_i} = f(Y_i, Y_j;\ U_i, U_j;\ Z_i, Z_j;\ d_{ij}, C_{ij})$$

$$i = 1,\ldots,n;\quad j = 1,\ldots,n \qquad (20)$$

where

M_{ij}/P_i = rate of migration from i to j expressed in terms of population in i.

Y = wage or income levels

U = Unemployment rates

Z = degree of urbanization

d_{ij} = distance between i and j, and

C_{ij} = friend and relatives of residents of i in destination j.

The specification of the function is usually log linear. Most of the research in rural-urban migration seems to be concentrated in the aggregated approach with some few studies following the micro approach (e.g. Hay (1974) and Nabi (1981)). All studies in the former approach use cross-sectional data, explaining point-to-point migration, usually between states and regions. Only a few of them deal with rural-urban migration and most use census data (see Yap (1977)).

The econometric work confirms that people usually move from places which are relatively poor to other areas of better employment and economic opportunities. When per capita income or wage differential are included they arepositively correlated with rates of migration (Barnum and Sabot (1976), p.258). When income levels in source and receiving areas are included rates of migration are

positively related to income in destination areas and negatively related to income in place of origin, i.e. $\partial f/\partial Y_j > 0$ and $\partial f/\partial Y_i < 0$. People also appear to be responsive to their chances of being employed in destination areas. In their study of Tanzania, Barnum and Sabot (1976) estimated a functional form with the expected wage differential as one of the explanatory variables, where the urban wage is adjusted by the probability of obtaining an urban job. They have found that this resulted in an increase of the explanatory power of the model (pp.71-72). With few exceptions, the distance coefficient in these functions where it is included is negative which indicates that in some instances distance could be deterrent to migration. Contact and relatives in destination areas are encouraging to migration because they provide the migrant with information about jobs and support during the period he is seeking them.

7.4 Limitations of the Empirical Work

The econometric application of models of rural-urban migration suffers from a number of shortcomings which result from difficulties in measurement of the variables, lack of appropriate data sets and the choice of the most suitable method of estimation. All this limits the usefulness of the estimated models for predictions and long term planning. The conclusions drawn remain suggestive and tentative. Among the problems which are enumerated is that the level of aggregation in inter-state migration in most cases conceals different patterns of migration. The demographic aggregation tend to hide the differential migration response of various subgroups with different characteristics. The geographic aggregation does not allow all moves within a country to be counted since in a country

substantial moves occur within the states and not between them. Moreover, interstate migration does not differentiate between rural to urban and urban to urban flows where in some countries migration to and between urban areas is an important component. There are also some problems with the migration variable used in some studies. For example point-to-point migration is measured in one of two ways, either as the people who moved from state i to state j during year t or the people counted in state j in year t who were born in state i. Both miss- persons who moved from j and away during the period of enumeration. When cumulative migration flows up to year t are used instead of point-to-point migration this results in bias in the estimated coefficients. Explaining cumulative migration flows up to year t with variables in year t results in simultaneous equation bias if post migration flows affect present wage and employment rates. In addition there are problems of measurement of the independent variables, particularly incomes in rural and urban areas. Accurate measures are difficult to obtain and require high material and human costs.

The micro approach too has to deal with some difficulties. Often one finds a function which expresses the zero-one migration variable M as a linear function of the independent variables

$$M_i = B_o + B_1 X_{i1} + B_2 X_{i2} + B_k X_{ik} + U_i \qquad (21)$$

where

M_i = 1 if migrant, 0 if not migrant

$x_1..x_k$ = the independent variables

U_i = an error term

If ordinary least squares were used to estimate (21) several problems arise (Stewart and Wallis (1981), pp.185-186). Let us assume that M_i is a function of only one variable X_i : $M_i = B_o + B_1X_i + U_i$. Since M_i can only take on the value of 0 and 1, we can deduce certain properties of the disturbance term U_i. The disturbance term U_i cannot be normally distributed. For any given X_i, U_i can only equal $(1-B_o-B_1X_i)$ or $(-B_o-B_1X_i)$. Since these are the only two possible values of U_i, they must occur with probability P_i and $1-P_i$ respectively, where P_i is the probability of a person being a migrant. Secondly, there is a question of interpretation and prediction. M_i takes the value 1 with probability P_i and the value 0 with probability $(1-P_i)$. Hence

$$E(M_i) = 1.P_i + 0(1-P_i) = P_i$$

Thus in the linear equation $E(M_i) = B_o + B_1X_i$ is to be interpreted as a probability. However the predicted value of M_i is given by $\hat{M}_i = \hat{B}_o + \hat{B}_1X_i$ and is not bounded and so may take a value outside the range (0,1). Finally the assumption of a constant variance will be violated. We have $P_i = E(M_i) = B_o + B_1X_i$. Therefore given X_i, U_i has two possible values which it takes with probabilities depending on X_i. Hence the variance of U_i will depend on X_i.

In 7.5.3 we will estimate an equation like (21) but we will formulate a model which avoids the second problem.

7.5 Migration Function for the Villages

7.5.1 General Features of Migration

The villages being situated in the areas of rainfed cultivation where the people derive part of their livelihood from the growing of the subsistence food crops are characterized by low economic opportunities and employment levels for almost all the year. The breakdown of income shows that people derive almost 50% of their income from non-farm activities while some 31% of the income comes from agriculture. Thus it is not unexpected to find that migration patterns are a fact of the social, cultural and economic life in the area. The pattern of migration is not different from the one that is observed in other areas of the Sudan similar in the geographic and economic conditions. Rural to rural migration where the migrants move to the areas of large scale culvitation of mechanized farming in the south-east of the country, particularly to Qadarif, are observed. Movements to the irrigated schemes in the Gezira and southward to the Rahad and the Blue Nile pump schemes are also recorded. In this case the movement is only for a short period of time lasting for two to three months and occurs after cultivation of own plot by the end of December and early January. By December the cotton picking season in the Gezira scheme has started and in the Qadarif area harvesting of mechanized dura crop is in progress. Movement is usually to the centres of agricultural production in Blue Nile and Kassala Province and northward to Khartoum the centre of commercial activities, government administration machinery and where most of the industry is concentrated. In this temporary migration the objective is to supplement the meagre income which is

generated during the period of rainfall. The period during which the person is absent takes up of between one and two months, followed by a period of return to the villages for a rest and then may be another return until the beginning of the agricultural season in June.

In the following analysis a migrant is defined as the member of the household who has been absent from the villages for a period of at least one year. This will exclude seasonal migration of the type just described, and let us concentrate on migration to urban areas. Table 7.1 gives the number of households in the villages who claimed at least one such outmigrant. 52 of the 152 claimed at least a migrant, which represents 34.2% of the total.

Table 7.1 : Number of Households with Migrants in the Villages

Village	Total Households	Household with Migrants	As percent of Total
Tamari	49	8	16.3
Tebeib	32	13	40.6
Unshamiq	18	14	72.7
Meallyab	13	4	30
Wad-el-Kashif	40	13	32.5
Total	152	52	34.2

Table 7.1 shows that the highest propensity to migrate is in Umshamiq followed by Tebeib. The reason for this in the case of the former seems to be the easy accessibility to means of transport since the village lies near a bus road. The high propensity to migrate in Tebeib could be attributed to the high population density in the

village with a consequent low availability of land per head and the low income which could be generated from it. As regards Wad-el-Kashif it is characterized by a high degree of inequality in land holdings. Fifty per cent of the households in our sample of this village were landless. The degree of concentration in land holdings is summarized by a Gini coefficient of about 0.71 (see Section 3.2).

Migrants in urban areas continue their familial ties with their families and kin in the villages and most of them remit some of the money which they generate in the urban areas back home to their rural source. Table 7.2 gives the distribution of annual remittances for families with migrants by size of land holding.

As Table 7.2 reflects 15.4 per cent of the Total remittances are received by the landless among families with migrants. Families with land holdings less than or equal to 10 feddans had 29 per cent of the total remittances. On the other hand large land owners received 55.6 per cent of the total. This implies that generally remittances go to the relatively better-off judging by the size of land ownership. Perhaps we should also point to the effect of international remittances. Among households in size class 15.5-20.5 one has a son working in Saudia Arabia who contributed 500 pounds of the 1340 pounds. The other thing to note as Table 7.2 denotes is that rural-urban migrants who come from families with no land or with small holdings are less likely to remit (compare the last two columns).

It is argued that one effect of remittances is to augment rural incomes and could lead to an increase in investment that raises output and productivity in rural areas. With imperfect capital markets

Table 7.2 : Distribution of Annual Remittances for families with migrants by size of Land holding

Size of Land Holding	Total No.of Households with migrants	Total Remittances (in pounds)	Remittances as percent of Total	No. of Households who received Remittances	No. of Households who did not receive Remittances
≤5.5	6	705	8.37	4	2
5.5-10.5	14	1740	20.65	10	4
10.5-15.5	7	800	9.5	6	1
15.5-20.5	6	1340	15.91	5	1
20.5-30.5	5	1560	18.52	5	0
30.5-40.5	3	360	4.27	2	1
40.5-50.5	2	324	3.85	2	0
+50.5	1	300	3.56	1	0
Landless	8	1296	15.38	5	3
Total	52	8425	100	40	12

TABLE 7.3 : Number of migrants for landowners and landless in the sample

Type of Household	No.of families	No.of Migrants	per cent of total
Small owners (less than ten feddans)	61	25	31.6
Large owners (greater than ten feddans)	48	39	49.4
Landless	43	15	19.0
Total	152	79	100

such remittances might be needed if villagers are to pay for physical capital and thus to embody in it technical progress that would certainly raise rural output per worker and per man hour.

In an argument by Stark (1975) families in rural areas may need to introduce new technology in the farm to keep output of food per capita from falling below a critical minimum. The introduction of new technology requires big investments and may involve risk. These big investments cannot be financed through borrowing because of imperfect capital markets. Neither can risk be spread because of the absence of crop insurance. In the face of this the objectives of accumulating a surplus for investment and spreading of risks may be achieved through migration. Remittances from household members working in urban areas provide the fund for procuring the inputs and by diversifying its income-earning portfolio the family will be able to disperse risks associated with new technology.

It is imperative, however, to look at the distribution of migrants among families with different size of land holdings. Table 7.3 gives the number of migrants for families with small and large landholdings and for those who are landless in our sample.

Table 7.3 shows that the largest number of migrants were from families who owned large plots. Those who owned small plots have the second largest number of migrants. Landless families sent out the smallest number of migrants. One possible explanation for this feature of migration in our sample could be that the sons of the bigger farmers might tend to be pulled out, assisted in bearing costs of urban job search by the bigger rural surpluses generated by village

inequality. It is reasonable to assume that other forms of wealth in the economy of the villages we are studying are correlated with land ownership, e.g. animal wealth. A big landowner will thus have the means whether directly by recourse to the assets which he owns or indirectly through access to formal or informal institutions of finance to assist in bearing the costs ofurban job search of his sons.

Propensities to migrate as we have seen from the theoretical and empirical account of rural-urban migration depends, among other things, on education. The explanation for this is that the structure of earnings in urban areas is positively correlated with the level of education attained. Employers are also more likely to hire an educated person than one with no education. The expected earnings in the urban areas are thus higher for an educated than for an uneducated person. This will tend to induce migration among the educated in rural areas. In Table 7.4 we give the distribution of migrants in our sample by education level.

Table 7.4 : Distribution of Migrants by Education Level

Education Level	No.of Migrants	Per cent of total
No schooling	17	21.52
Khalwa	5	6.33
Primary	30	37.97
Junior Secondary	20	25.32
High Secondary	5	6.33
More than high Secondary	2	2.53

As Table 7.4 shows the majority of migrants in our sample had some form of education. The migrants are also dominated by those who have primary and junior secondary education.

One would expect the education levels to vary among the households in the villages according to the particular, historical, social and economic circumstances which prevailed throughout the years. In the early stages of the introduction of formal education in rural communities people were reluctant to enrol their children in schools, and especially among the nomads where continuous movement in search of grazing land for animals had made it difficult to provide the necessary establishment of permanent structures and the conditions that would be conducive to the development of an organized form of education. Obviously the social values at the time would tend to put more virtues on the future labouring power and the social security which children would provide. However with changing attitudes those who can afford to allow some of their children to go to school are those who are relatively in a better level of material well being that could permit them to endure the loss of their labouring force. With further changes in the social values and as the benefits which education can bring, whether politically or economically, are realized among direct relatives and kin and in the villages at large, an increase in private demand for education would ensue. The impact on those who are deprived of ownership of the means of the production or who own a small plot will be more pronounced and to them investment in educating their children becomes of prime importance. For this group, unlike for big landowners, demand for labour power to work the fields or for supervision, if labour is hired, may be smaller. This could enable them to release some of their children for full time education.

In order to compare the education levels for families with migrants and families without migrants among the different category

of land ownership we have constructed an education index for the adult members in the family. Adult members who have no schooling, Khalwa, primary, junior secondary, high secondary and more than high secondary are assigned the numbers 0, 1, 2, 3, 4, 5 respectively. The mean value for the adult members in the family is taken to represent an education index for the household. Table 7.5 gives the average of this index value for families with and without migrants and according to the category of land holdings.

Table 7.5 : Average Education Index for Families with and without migrants and by type of land holding

Type of Household	Index for families with Migrants	No. of house-holds	Index for families without Migrants	No. of house-holds
Small owners(1)	2.85	20	1.73	41
Large owners(2)	2.50	24	1.58	24
All Landowners	2.66	44	1.72	65
Landless	2.63	8	1.30	35
Total Households		52		100

Notes: (1) Small owners are those owning a plot 10 feddans or less in size

(2) Large owners are those owning more than 10 feddans

(3) For explanation of education index see above

We see from Table 7.5 that the overall average education index is higher in all groups of families which reported a migrant than for those wo did not have a migrant. And among families who claimed a migrant landowners display a larger education index than those without any land. However, among Landowners small land owners show a higher index than large land owners.

Another feature of migration in the villages is that it occurs among the young male persons. Table 7.6 gives the age distribution of migrants in our sample.

Table 7.6 : Distribution of Migrants by Age

Age Group	No. of Migrants	Per cent of total
16-21	20	25.3
22-31	34	43.0
32-41	22	27.9
+41	3	3.8
Total	79	100

As Table 7.6 shows 68 per cent of the total number of migrants are in the age group 16-31. A quarter of migrants are in the age group 16-21. This implies that migrants start leaving their villages after they finished their primary and/or junior secondary education. This association between age and migration is universally noted. This age pattern of migration rates are rationalized in terms of the higher reward for migration while young, when the present discounted valueof income increments in the destination is maximized (Sjaastad, 1962).

Finally we look at the destination of migrants from the villages. Table 7.7 gives the places of residence for migrants who were born in all the villages. From the table we can see that the capital city (The Three Towns : Khartoum, Khartoum North and Omdurman) attracted the largest number of migrants. The rest of the migrants were distributed among the other provinces of the country. Another

feature of the table is the number of people who migrated to other countries in the Middle East which reflects the latest trends in the country of increasing numbers of people leaving the country to work in the oil exporting Arab countries.

Table 7.7 : Rural-Urban Migration : Destination

Town	No. of Migrants		Population of Town (1)
Khartoum	24	Khartoum Province	784294
Khartoum North	1		150989
Omdurman	19		299399
Wadmedani	3		106715
FAO (2)	2		
El Managil	5	Central Region	15223
Sennar	2		28546
El Roserres	1		12951
Ed Damazin	1		12233
El Hasaheisa	1		18747
Es Suki	2		16197
El Obeid	3	Western Provinces	90073
El Da'ein	4		18457
Umm Rawaba	1		19713
El Hawata	1	Kassala	7841
Shendi	1	Northern	24161
Juba	1	Southern Provinces	56737
Malkal	2		34894
Abroad (3)	5		

(1) Source: Department of Statistics, Sudan Second population Census 1973 (Khartoum. 1977).

(2) Centre of the Administration of Rahad Scheme

(3) Saudia Arabia and Gulf States

A clear pattern in destination of migrants from each of the villages with the highest rates of migration was observed. Most of the migrants from Umshaniq for example lived in Khartoum and Western Provinces. Migrants from Tebeib lived in towns in the Central

region and southern provinces. For Wad-el-Kashif the majority reside in Omdurman. Another aspect of destination is related to households who have more than one migrant. For some cases migrants from the same household live in the same town. This feature of migration underlines the significance of the spread of information about urban job opportunities whether by those who leave the villages first or through people from the same village who get in contact with them in urban areas and who bring the news home. It also points to the relevance of the presence of relatives in urban areas for migration.

7.5.2 Probability Function of Migration

Our unit of analysis for the probability function is the household. We presume that the decisions to migrate are taken jointly by the household. This presumption could generally be supported by some of the features discussed and revealed in the analysis of the last section. We have seen how members who migrated continue to reciprocate by sending money back to the cultivating unit in the place of origin and to this extent financial decisions and resources seem to be implicitly allocated jointly. Members who have already moved would also tend to discuss and provide information and impart their knowledge of possible employment in urban places with those of the households who have not moved and encourage them to find employment outside the area.

An important variable which the family would conceive of when deciding whether to encourage the migration of a son is the income which an adult son earns while staying in the village. For the purpose of our analysis we are going to assume that the income which

accrues to an adult member is equal to his share in total output produced by the family since the main source of labour employment is work in the family farm. Further we are going to assume that adult members share both work and output equally (Sen, 1966). Thus we will take the income of an adult member to be measured by the output value per adult member (AVOUT) rather than the marginal product of the working member. AVOUT can be taken to represent the opportunity cost for the migrant to the urban areas. We will expect that the higher AVOUT the less likely a person will be encouraged to leave to urban areas. Therefore this variable will be inversely related to decisions to migrate.

A second variable which affects decisions to migrate is the land which is available to the family. One can argue that the more land that is available per working member of the family the less likely the person may be induced to migrate. If more land is at the family disposal all the labour in the household may be required for utilizing it. On the other hand one may invoke the argument emphasized in the last section about the relationship between the ability of large land-owners to finance the urban job search of their sons and migration. Therefore we would expect to see either a positive or negative effect of land owned per adult (AVHOL) on migration.

A member of the household could have access to jobs in the rural areas outside his family farm as well. In our sample income generated from non-family farm is earned through activities in the rural areas during the period of the agricultural season but mostly during the period of the dry season in the villages. One can argue that this is an important variable which influences the household's

decision relating to migration. If the household is assumed to base their decisions on migration on maximization of their expected income over their life-time then the non-family farm earnings represent an important constituent in this income. Also, an important feature of migration to urban areas in Sudan is that it occurs through a two-stage process. The first stage when the migrant leaves his traditional cultivating villages to supplement his farm income by working in the areas of irrigated cultivation or large mechanized rainfed cultivation as we described in Section 7.5.2. The second stage occurs if the migrant decides to leave to one of the towns which lie near the large schemes. We can therefore take the non-family farm income as representing the true opportunity cost of joining the urban labour market. In our migration equation we will measure this cost by the amount of non-family farm income per adult in the family (DSINCM). It should be clear that the non-family farm income does not include remittances sent by migrants. One would expect that the higher DSINCM the less the incentives to move finally to urban centres. So this variable will be negatively correlated with decisions to migrate.

Another variable which influences migration is education. The results of some enquiries into the factors encouraging migration to the capital city support the hypothesis that education plays a significant part in such a process (Galal El Din 1974). Our analysis in the last section has shown that families with migrants have higher educational achievements, as measured by the index we defined there, than those without migrants. We have also given some reasons there why one would expect a positive relation between migration and education. In our migration function we will take the education index for the adult members (AVEDN) to represent approximately the

effect of education on migration and expect it to be positively related to migration.

Finally we will include two other variables which may capture the effect of mechanization in the decision to migrate. These are the two dummy variables M1 and M2 which we introduced in the chapter on tenancy. M1 takes the value of 1 if the farm is partly mechanized and 0 otherwise. M2 takes the value of 1 for a fully mechanized farm and 0 otherwise. It could be argued that mechanization may lead to displacement of labour and reduce employment opportunities in rural areas. Thus we may expect M1 and M2 to be positively related to migration.

Having specified the variables that we want to include in our migration equation we will write the migration function as

$$M_i = f(AVOUT, AVHOL, DSINCM, AVEDN, M1, M2)$$

where M = 1 if the household had a migrant
0 if not, and

AVOUT = Farm output value per adult
AVHOL = size of Landholding per adult
DSINCM = Non-family farm income
AVEDN = Education Index for Adult members in the family
M1 = 1 for a partly mechanized farm
0 otherwise
M2 = 1 for a fully mechanized farm
0 otherwise

In order to test the effect of the above variables on migration we will estimate the following linear regression equation

$$M_i = B_o + B_1 \text{ AVOUT} + B_2 \text{ AVHOL} + B_3 \text{ DSINCM} + B_4 M1 + B_5 M2 + U_i \quad (22)$$

where U_i is an error term and $i = 1,\ldots,N$. If we denote the independent variables on the right hand side of (22) by x_i's we may write

$$M_i = \sum_{r=0}^{k} B_r x_{ir} + U_i \quad (23)$$

In matrix notation (23) can be written as

$$M = XB + U \quad (24)$$

where M is a vector of observations on the M_i, X is a matrix of observations on x_i's and B is a column vector of the parameters B_r and U is a column vector of the disturbances U_i. In 7.4 we have seen that

$$P_i = \text{Prob}(M_i = 1) = E(M_i) = \sum_{r=0}^{k} B_r x_{ir} \quad (25)$$

We cannot apply ordinary least squares (OLS) to estimate the parameters in (23). One problem with applying OLS is that OLS may lead to a vector of fitted values $X\tilde{B}$ some components of which do not satisfy the condition that

$$0 \leq P_i \leq 1 \quad (26)$$

One possible solution which is suggested by Cox (1970) is to turn to a type of model in which the constraint (26) is automatically satisfied. Cox (1970, pp.14-19) suggests that the simplest way of representing the dependence of a probability on explanatory variables so that the constraint (26) is inevitably satisfied is to postulate a dependence for $i = 1,\ldots,N$

$$P_i = \frac{e^{X_i B}}{1 + e^{X_i B}} \tag{27}$$

$$1 - P_i = \frac{1}{1 + e^{X_i B}} \tag{28}$$

where X_i is the i^{th} row of the matrix X and B is the column of unknown parameters B_r's. Equations (27) and (28) are equivalent to:

$$\lambda_i = \log\left(\frac{P_i}{1-P_i}\right) = X_i B = \sum_{r=0}^{k} B_r x_{ir} \tag{29}$$

or collecting the n values $(i=1,\ldots,N)$ together we can write

$$\lambda = XB \tag{30}$$

where $\lambda_i = \log(P_i/1-P_i)$ is called the logistic transform of the probability P_i and (30) is a linear logistic model.

Now let $M_1,\ldots,M_N$ be independent binary random variables distributed in accordance with (30) and let $m_1,\ldots,m_N$ denote the corresponding observed values. Then the likelihood contains a

factor (27) whenever $m_i = 1$ and a factor (28) whenever $m_i = 0$. Thus the likelihood is

$$L(B) = \frac{\prod_{i=1}^{N} e^{X_i B m_i}}{\prod_{i=1}^{N} (1+e^{X_i B})} \qquad (31)$$

The set of coefficients B_r could thus be estimated as the values that maximize the likelihood function L(B) and the estimated coefficients will be asymptotically consistent.

7.5.3 The Regression Results

Maximum likelihood estimates of the coefficients on the variables in our migration equation are shown in Table 7.8

Table 7.8 shows that all the included variables in our migration equation, with the exception of land holding per adult (AHOL), are statistically significant. All variables turned out with the signs which are consistent with our a priori expectation. The higher the output per adult produced in the family farm the less likely that the family will encourage migration of some of its members. Since we have taken this variable as a measure of the opportunity cost of joining the urban markets for an adult member, the higher this cost the less likely that a member will leave to urban areas. Income derived from employment in non-family farms too is inversely related to the probability of migration. Thus a rise in employment opportunities outside the family farm in the villages or outside the village in other rural areas will discourage migration.

Table 7.8 : Regression Results : Rural-Urban Migration; Linear Logistic Model : Dependent Variable

M_i = 1 if a household has a migrant
0 otherwise

Variable	Coefficient	t-statistics
AVOUT	-2.439	-1.72**
AVHOL	0.02	0.669
DSINCM	-3.90	-3.57*
AVEDN	1.42	5.124*
M1	0.521	1.629**
M2	0.49	1.909**
Constant	-1.689	-2.477*
Total observations	152	

* indicates significance at 5% level of significance
** significant at 10%

The education index AVEDN is positively related to the probability of migration. This implies that the higher the educational achievements of some of the members in the family the more probable that they migrate to urban areas in expectations of high levels of payments for the attained qualifications. Alternatively, the higher the level of literacy in the family, the more open to change, more informed of jobs in urban areas, and more easily oriented towards urban values of living. This could encourage migration of one or more of the members of the family.

Mechanization of farms whether of all cultivated land or part of it is positively related to migration. Mechanization could reduce the employment opportunities in the family farm as well as at the village at large. Labour thus displaced may resort to migration

to seek the work at urban areas.

7.6 Conclusion and Implications

This chapter has been concerned with rural-urban migration in our sample of villages. Analysis of data pertaining to the household has shown a number of points. Firstly rates of rural-urban migration are high when a village is characterized by a low land/man ratio They are also large when there are large numbers of landless and the distribution of land is highly unequal. Easy accessibility to means of transport could also lead to high rates of migration. Rural-urban migration occurs among the young, educated males in the villages. Thus rural-urban migration deprives rural communities of people who could be most productive and most innovative. Thirdly migrants in urban areas maintain their relations with the village community after they leave. They sent remittances which could be needed in the production process in rural areas. However, a large part of the remittances sent by the migrants from the villages is received by the relatively better-off in the community. Families with large land holdings sent out the largest number of migrants. Migrants from better off families are more likely to send remittances than those who come from families disadvantaged in terms of ownership of assets (land). Fourthly most of the migrants are attracted to the capital of the country. This can be explained by the concentration of investment in industry in the capital and the proliferation of governmental bureaucracies and petty activities in the commercial sector. Most of the high education institutions are also located in the capital.

The specific examination of the factors that determine

migration in the household setting has pointed to a number of facts. Rural-urban migration is related to the economic opportunities that prevail in the villages during the agricultural season as well as in the surrounding rural areas which offer such opportunities in the dry season. The results of the estimation of the migration function for the villages implies that improvements in the productivity of cultivated farms and the rise in income which follows such improvement could reduce the drift to urban areas. It also implies that if more income could be derived from off-farm employment in the villages and in surrounding rural areas this can discourage rural-urban migration. Secondly, mechanization could aggravate the problem of migration since it leads to displacement of labour and loss of work and income. Finally, migration and education are positively related. The relationship between education and migration is obvious : those who are best educated have the best chances of securing an urban job.

CHAPTER 8 - Conclusion and Policy Implications

We will not give here a detailed summary of all findings of this research. A summary of findings for each one of the topics we dealt with can be found at the end of each chapter. Our aim here is to give an overview of findings with a particular emphasis on their implications for policies of development of rural areas. The hypotheses which we tested and the structure of markets will be at the centre of the discussion. We will also offer some suggestions for future research.

We begin with labour. In the discussion of the labour market in Section 3.3 we have been primarily concerned with an examination of the theoretical implications of a model for the determination of wages that postulates a functional relationship between productivity of labour and the wage or consumption. As we explained in Section 2.2 the idea is that the worker's productivity or the number of effective tasks per day depends upon his consumption which in turn depends on his wage. In the model the employer chooses wages so that the cost per task performed is minimum. This can lead to a wage per day above the market wage rate. Another implication of the model is that if the theory gives an important explanation of wages one would expect to see long term employment contracts. We argued in Section 3.3 that the theory does not seem to be applicable to the determination of wages in the sample of villages we studied. We have seen that the wage level in the villages seems to vary across the agricultural seasons in accordance with the strength of supply and demand. Further, a particular feature of the labour markets in the villages

is the dominance of short term day-to-day contracts and the absence of long term employment.

It was, however, argued in Section 2.2 that there are some general implications of the relationship between consumption or dietary and health improvements of undernourished workers and productivity that need to be considered. The interaction between the consumption patterns of households, the allocation of resources in agriculture and the demand for labour are some of these.

In the analysis of consumption in Chapter 4(Section 4.4) where a linear expenditure system was used it was found that for the average household in rural central Sudan the perceived minimum subsistence expenditure on food falls short of the value of a food bundle that is thought to satisfy the required amount of diet necessary in terms of calories and protein. If consumers are aware of the link between consumption and productivity a number of reasons may account for the fact that food consumption expenditure is less than necessary to make them fully active and productive. The low level of income in rural areas may account for such outcome . Increases in consumption expenditure could, therefore, be achieved through raising the income level of the agricultural population.

We have argued that the increase in income can be generated by providing incentives and resources to agriculture for production of food - in contrast to currentpolicies that concentrate on production of cash crops - which would be productively consumed.

The analysis has revealed that there are several reasons to expect an additional income generated in rural areas to be used for productive body-building consumption of food. First, consumption expenditure is at low levels in rural areas and more food needs remain unmet. Thus a large part of an increase in income could be spent on the purchase of food. As the data analysis of consumption expenditure has indicated if total expenditure per capita or "income" is increased by one marginal unit 58 per cent of this increase will be allocated to food. There is also evidence that with rising per capita incomes a larger proportion of income allocated to food would be spent on items that are rich in calories and protein content, e.g. livestock and milk products. These products the demand for which increases with per capita income use labour intensive techniques in the production process. Thus investment in these products would lead to an increase in demand for labour and a rise in wages or incomes. It is possible, however, that the home production might fall short of satisfying all the increased demand for the agricultural commodities. Under such circumstances, part of the increased demand might be satisfied through imports. This would be most unfortunate if production of some of these commodities, e.g., milk, could be produced at relatively low cost to the economy.

An important determining factor, however, of the structure of demand for goods and services is the income distribution. If a large part of the extra income generated from the production of farm products accrues to a relatively small group of people this may lead to an increased demand for luxury goods and sluggish growth of effective demand for basic food stuffs and consumer goods. A

relatively equal distribution of income is, therefore, necessary for a wider and more effective market demand and in order to keep the poorest strata of the population above a certain minimum subsistence or "poverty line".

The analysis of income distribution in Section 4.6 gave an idea of the magnitude of income inequality in rural Sudan. It was found that the lower-income 80 per cent of families in our sample received only about a third of the total income while the upper 20 per cent received two-thirds of the income. This degree of inequality in income is summarized by a Gini coefficient of 0.52. This is a high degree of inequality compared with the ones found in studies of rural areas in the Northern Sudan and for the country as a whole. This inequality in income distribution can be traced to the inequality in land distribution, land being the most important asset for income generation in rural areas. We will turn to land distribution below.

Another cause for the inquality in income distribution might be related to the fact that substantial amounts of investment in the agricultural sector in Sudan are directed towards the central areas of the country. In addition to creating disparities in income distribution between the central area and other parts of Sudan, this could have led to an uneven development within the former, with some places benefitting considerably from the investment in irrigation works, introduction of multiple crops and infra structure while others remaining largely subsistence with low levels of productivity and incomes.

Given the inequality in income distribution referred to above the extent to which the basic needs of the population in the rural areas will be met depends on the degree of equality that can be achieved. One way in which a less unequal distribution of income could be attained is through the use of the instrument of fiscal policies that are available to the government. The effect of one such instrument namely, taxation, has to be analysed.

In Section 4.6.2 we tested whether the prevailing system of direct taxation has any effect in reducing the extent of income inequality. The distribution of post tax income indicated that the direct taxes had more or less a negligible effect on the reduction of disparity in incomes. This was attributed to defects in the direct taxes that apply to agriculture. The most important of these are the land tax in riverian areas, ushur in rainfed cultivation areas and the animal tax. We have argued that the most distinct feature of the land tax is its inflexibility. The rates of the tax which applies today have remained unchanged for generations despite the considerable rise in agricultural prices and income. It was also argued that both the land tax, ushur and animal tax are proportional taxes which lack any progressivity in their rates. Thus, with a proportional land revenue and a large marketed surplus, the bigger landowners would be lightly taxes. We have also said that the income which is derived by the rural population from jobs outside the agricultural sector is not subject to taxation due to the absence of a personal income tax that applies to the agricultural sector. Also, a distinctive characteristic of the income taxation in Sudan (which includes, in addition to the personal income tax, the business profit tax and land rent income tax) is that it is applied mostly to large companies in the urban modern sector which keep proper accounts

and to individuals who pay their income tax through the system P.A.Y.E. (pay as you earn).

Income generated in rural areas, would, nevertheless, remain largely correlated with the land ownership in the agricultural sector. Thus the distribution of income is most directly associated with the distribution of land. The distribution of land was studied in Section 3.2. We have found that in the sample of farms we have studied 28 per cent of the families own no land of their own and hire in land for cultivation at fixed rent. Another 15 per cent own small plots of land which are five or less feddans in area. On the other hand, at the top of the distribution only 3 per cent of the households owned about 19 per cent of the total land. A Gini coefficient of 0.57 is calculated as a measure for the inequality in land holdings.

A policy of land distribution will no doubt help in alleviating the poverty of the population, i.e. the landless tenants and the small cultivating owners. But in order that a policy of land distribution achieves its objective of raising income and living standards, it should be accompanied by increased employment and productivity. The theoretical literature discussed in Section 2.2 showed that small farms could sometimes be more productive than large farms. Thus it is argued that under such circumstances that redistribution of large farms into small ones could be conducive to employment and output in rural agricultural areas. The question, however, is of whether redistribution of land could be feasible. For in many L.D.C.'s some political and social factors may stand against such a change. Often the political structure in these countries is such that the large landowners have a great influence on

the government and could prevent any land reform taking place. Another thing is that, as will become clear in a moment, if a redistribution is carried out it would be necessary to accompany it with a carefully designed extension service programme which could provide the small farmers with the farm inputs which they lack. This would mean that large efforts and supervision would be needed from the government.

In Section 5.4 we found that farm productivity to be invariant with respect to cultivated land for three out of the five villages we studied. For the rest of the villages output per feddan of cultivated land was found to be increasing with size of farm. Across the villages an increasing relationship was observed.

We may ask if the reasons which were given to explain why one might find a negative relationship between output per unit of land and size of farm apply to the villages we studied. As we explained in Section 2.2 Sen gave two arguments why an inverse relationship between size of farm and productivity may hold. First, he suggests that small family farms apply more labour per acre of land than large farms and therefore get more output per unit of land than big farms. This is derived from the proposition that small farms use labour beyond the point where marginal product equals the wage rate. Second, he suggests that small farms may have better land quality than large ones. The reason for this, he assumes, is that population growth on more fertile land has been faster.

We have noted that for the two villages where we found productivity to be rising with size of farm more inputs per feddan

are used in large rather than small farms. In particular the greater use of mechanical methods of cultivation is observed for large than for small farms. We have said that the use of these methods could reduce to a large extent the requirement for labour inputs, particularly in ploughing and sowing which in the absence of tractors would be done by hand. Labour productivity would therefore be higher on larger farms. Total mandays in the two villages were also found to be rising in large farms and family labour constitutes a large per cent of the total used. We have also observed that for the villages as a whole the average family size is higher for large than for small farms. Thus it appears that families with large family size cultivated large areas of land.

We have also argued that one explanation why small farmers could not exploit the modern techniques of production (tractors) is that most of them are tenants who lack the means of hiring the tractor services or the assets which could avail them were they to borrow the money for the services and had to face a failure in crop production. Small cultivators may thus be risk averse and make no use of the advanced means ofproduction or apply it only to a limited extent.

We saw also from the analysis in Section 5.4, when we split labour into a slack season labour (used mainly in ploughing and sowing) and busy season labour (threshing and harvesting labour), that slack season labour is characterized by a low marginal productivity compared to busy season labour. This suggests that there may be significant advantages in introducing other employment activities beside cultivation of the main crop (dura) during the slack season. The

encouragement of a "mixed" farming system, for example, where livestock and dairy production becomes an integral part of production will have significant repercussions on labour productivity and incomes.

The results which we found for the relationship between size of farm and productivity have some interesting implications. We have suggested above that a policy of land redistribution could help greatly in alleviating poverty in rural areas especially among the landless and the small cultivators. As we have seen while output per feddan is found to be proportional to size of land operated in some of the villages we studied, it is increasing with size in others. Thus while a land redistribution in some of the villages might have an adverse effect on total production it would not affect total productivity in others. The overall result would depend on the extent of provision of farm inputs (tractors) and services (credit) which small farmers are lacking now after a redistribution takes place.

We have seen also that the size of cultivated land is less unequally distributed than the ownership. We have also found that there is no difference between owners and tenants in production. Therefore an initial step in a government programme for land reform could be a policy that gives ownership rights to tenants.

The market for tractor hire as was shown in Section 3.5 is characterized by monopoly control by the few owners who were able to purchase them. This monopoly control, it can be argued, is a consequence of defects in government policies towards the "grain" production sector which tended to neglect the communities of small

cultivators who lack the means of improving production and output. The government policies can be described as being biased in favour of large scale cultivators, e.g. private mechanized farming in Qadarif. The subsidized farm inputs like tractors, and also the credit which is allocated to the purchase of these inputs largely benefit these few large scale owners (see Chapter 1). Village communities at large benefit from these subsidized inputs when these large scheme owners hire their services out. But even in this case access to the inputs is possible only for the well-off among the village community.

One way in which monopoly in tractor hire can be broken is by direct govenment intervention in the market or indirectly in collaboration with the villagers. The government can intervene by establishing a tractor-hire service in each of the villages or group of villages together. If, as we have argued, small cultivators are precluded from the use of tractors because of inability to hire them and of risk averseness a tractor hire unit could benefit the community in many ways. The unit can serve as a technique for securing acceptance of improved practices or more productive techniques. Secondly the income earned from tractor hire would accrue to the government which it can use in provision of further services for the village community e.g. better seeds, credit facilities and fertilizers which are at present absent from use and which should accompany tractor cultivation if soil erosion is to be avoided. It is important to recognize that at the moment income earned by tractor owners from hire of services escapes taxation. Needless to say that some organizational problems might face a hire-unit. Some of these would arise because of the indivisibility of the input provided. For example a tractor can be hired out to only one farmer at a time if more than an individual

requires it use. An arrangement which is followed in the free markets in the villages, but which does not solve the problem completely, is to give priority in service to whosoever comes first. Other problems may arise because the administrators of the unit who would be employed by the government might not be well motivated in solving problems that may arise abruptly, e.g. breakdown of tractors, in a swift and prompt manner as the private owners who seek profit maximization.

As an alternative to direct government intervention in the market, the tractor hire unit can be set up by a village cooperative and the government can help by providing the money for purchase of tractors on credit basis. One advantage of a cooperative system would be that risks and uncertainty can be borne collectively for the individual farmers involved in the effort.

The market for hire of land was discussed in Chapter 6. We argued in Section 6.4 that demand for land can be explained largely by factors that are less than perfectly marketable. One such factor which can be described as being imperfectly marketable in the villages is labour. Most of the people in the villages prefer to work in the family's own farm than offer their labour for hire. The statistical analysis confirmed that the availability of adult family labour is positively related to land hire in the villages. The effect of capital services such as tractors which works with labour in utilizing land, on the demand for land was also examined. The analysis indicated that farm mechanization can encourage farmers to lease in land. This has a direct implication

for inequalities in the villages, in particular under present market conditions where it is the well-off (large land owners) who tend to use tractors on large scale.

The labour market was further analysed in Chapter 7 by considering the migration flows of labour from rural to urban areas. These migration flows are considered to have important effects upon several problems of the development process such as employment or regional development. So an increased understanding of the determinants of migration can aid the formulation of development policies.

An examination of the factors that influence rural-urban migration was undertaken in Section 7.5. A probability function of migration was estimated in 7.5.2. The result of the exercise indicated that migration is related to the level of economic opportunity in rural areas. The propensity to migrate is found to be higher the lower the per capita income which the family can obtain from crop cultivation. Migration to urban areas was also found to be inversely related to the level of income which can be earned from undertaking jobs outside the family farm in the villages or in other rural areas. Income earned from outside the villages in other rural areas is obtained through the process of rural-rural migration, which takes place during the dry season of the year. Easy access at cheap prices to other rural areas of production (mechanized farms and irrigated schemes) and improvement of terms of employment, e.g. the imposition of a minimum wage, could raise the level of net income obtained through rural to rural migration and thus may discourage migration to urban areas.

Similarly, government policies which would make available means of production like land (through land distribution, an important aspect for the villages when we bear in mind the high number of landless families), capital services and credit facilities (e.g. through the establishment of a system of cooperatives) would contribute a lot to raising earnings from employment in rural areas and therefore lessen the incentives to move to urban centres. The results indicated also that mechanization encourages migration. Mechanization displaces labour in two ways. By encouraging landowners to increase the size of their cultivated land it reduces the supply of land which can be offered for lease and displaces tenants. It reduces too, the demand for labour to carry some of the agricultural operations andtherefore competes with the jobs which could be available for thelandless agricultural workers. These unfavourable effects of mechanization might be raised against us for recommending mechanization. But it should be noted that we have also recommended a policy which gives ownership rights to tenants, establishes cooperatives and creates other employment opportunities through the introduction of a mixed farming system.

Village-end variables are but some of the factors that induce migration to urban areas. The expected level of remuneration of labour in these areas could also motivate migration. It has been argued that in developing countries the structure of earnings in urban areas is higher the higher the formal education level attained. The chances of getting a job among the educated is also high. Thus the educated are most likely to migrate. The estimated probability

function of migration also indicates that the propensities to migrate from the villages increase with the education level.

Suggestions for Future Research:

Further research on the topics which we discussed in this thesis would, needless to say, help in increasing our understanding of the functioning of the rural economy of the Sudan. We think particularly of research which would involve more villages in the same area where we conducted this research or a cross-section of a number of villages throughout the country. The research should make its objective further analysis at a number of points. We consider some of these.

In tenancy we will need to know more about types of contracts in other villages and the reasons for their existence. The study would require a close examination of the labour markets and the markets for other factors, e.g. tractors if they are used and the credit market. More interesting points in the determination of tenancy could be discovered for example from studying villages where draught animals are still used.

Secondly, on migration as we have seen we had been concerned with variables at the village level which determine migration. Information about migrants was obtained by interviewing the families in the rural areas. We think that in future research such a process should be complemented by collecting information from migrants in receiving areas through direct contact. The tendency of migrants from the same village to live in the same town would help in reducing

costs of travel and research largely. A follow up of the migration process in this manner at both recipient and originating areas would assist in knowing about the motives for migrating, how migrants live while searching for a job, the support which they have while looking for a job, the jobs and search process in which the migrant is involved before settling to a final job. An important thing which would need to be studied carefully is the allocation of remittances between consumption and production activities. In our study we assumed that, due to the almost absence of a credit market particularly at the beginning of the season when money is most needed, these remittances could be used for purposes of production.

Thirdly, further study on the system of agricultural taxation in Sudan and the impact of the tax on income distribution is needed. To our best knowledge no study on agricultural taxation in Sudan is being carried out. One study could be directed to examining the income elasticities of the agricultural taxes. Further, a full inquiry of the incidence of taxation in the agricultural sector, both direct and indirect taxes, is required.

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